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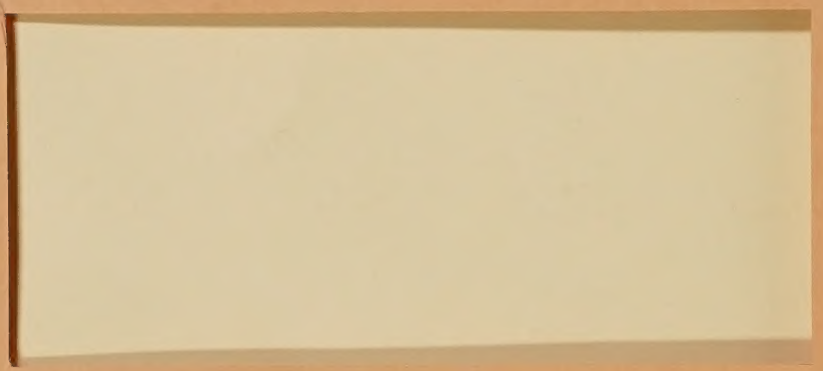
# Animal Science and Health

# in

# The People's Republic of China



# Animal Science and Health

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# ANIMAL SCIENCE AND HEALTH IN THE PEOPLE'S REPUBLIC OF CHINA

by

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All comments, opinions, and recommendations in this report are those of the team members and not necessarily those of the sponsoring institutions. The study tour was jointly sponsored by the USDA Office of International Cooperation and Development and the Ministry of Agriculture of the People's Republic of China.

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# INTRODUCTION

Between May 17 and June 17, 1980, a team of U.S. scientists under the leadership of George Lambert, a veterinary medical officer of the U.S. Department of Agriculture, visited the People's Republic of China, with the purpose of learning the state of swine production in the People's Republic of China.

The U.S. Team (see p. 136) visited several key sites in the People's Republic of China where animal husbandry and veterinary medicine are significant. These included Beijing, Harbin, Urumqi, Shanghai, and Guangzhou.

This report is the composite report of the team, recounting what the team was briefed by the Chinese officials and scientists, and what the team observed. While the report is not comprehensive, it does produce basic information on the state of swine production and other aspects of animal science and health in the People's Republic of China, and indicates the direction for future cooperation in animal research between the United States and the People's Republic of China.

## Beijing Bull Stud

The station was established in 1973 with the purpose of providing frozen semen for the improvement of the black-and-white cattle (Holstein) and yellow cattle in the Beijing area. The station occupies 4 ha and is operated by 35 staff members. The staff members include 8 engineers (college graduates), 4 mechanics, 5 drivers, 6 technicians, and 12 caretakers. The arable land on the station was planted with vegetable crops for the workers.

The station maintained 25 beef bulls and 25 dairy bulls. The dairy bulls were exclusively black-and-white cattle. Beef breeds included Horned Hereford (England), Polled Hereford (Australia), Charolais (France), Simmental (West Germany), Angus and Murray Grey (Australia), and Japanese cattle.

The station produces about 500,000 doses of semen per year. Most of the semen is frozen in pellets; a small quantity is frozen in straws. Semen handling was very similar to that in the United States. Penicillin was used in the semen. Forty percent of the semen from this station was used in the Beijing area and the rest in the provinces.

The feeding program was based on hay supplemented with a concentrate of wheat, barley, corn, wheat bran, soybean cake, fish meal, minerals, and vitamins (A, D, and E). Shredded, dried carrots were also used.

Bull selection methods were similar to those used in the United States. Bull mothers were chosen from the upper 1 percent of the females in the area, based on appearance, milk production, and conformation. Milk production was based on a 305-day lactation and 3.6 percent butterfat content. Bulls from the best 40 or 50 bull mothers were initially chosen. At 6 to 12 months of age, the 10 to 15 best young bulls, based on their conformation, are retained for progeny testing. About one of every five progeny-tested bulls is kept for frozen semen production. The progeny test is based on information from 200 progeny. The Chinese indicated that information from relatives is also used.

The beef bulls at the station are imported bulls with no record of performance. The Chinese indicated that a selection program based on adaptability, conformation, feed efficiency, and rate of gain was to be begun soon.

Young bulls coming into the station are tested only for tuberculosis and brucellosis.

Vitually all of the dairy cattle and a high percentage of the yellow cattle in the Beijing area are mated by artificial insemination (AI). The Chinese reported a 60 percent conception rate to first service and a 92 percent yearly conception rate. Conception status is determined by rectal palpation at 2 months after breeding.

Yellow cattle are being bred to dairy and beef bulls to upgrade the yellow cattle to dairy or beef types. The dairy and dual-purpose dairy-yellow cattle crosses will be used in the area around large cities, whereas the beef types will be used

in the rangelands. The current thought is to upgrade their yellow cattle to the level of Simmental.

The Polled Hereford and, to a lesser extent, Horned Hereford, appeared similar to the U.S. types of about 20 to 30 years ago: small-framed, short-bodied, wasty-middled, early-maturing types with a low lean-to-fat ratio. The one Charolais bull was smaller than that desired in the United States and had weak hind legs. The Simmental cattle were good as a group; one bull was outstanding in frame size and leanness. Several of the black-and-white bulls appeared to be more dual-purpose than U.S. Holsteins. Perhaps their best black-and-white bull was produced from U.S. frozen semen.

The testing scheme appeared to be right out of the textbook. Apparently, the station is just beginning to get progeny-test information on the bulls in the stud. Overall management was good. Several delegates were impressed with the exercise device for the bulls. The bull was attached by a nose ring and chained to a stranded wire cable of about 50 yards leading out from an open-fronted shed, so that he could move back and forth freely.

Red Star Poultry Farm

The Red Star Poultry Farm, near Beijing, has 200,000 layers, 40,000 brooder chicks, and 70,000 replacement layers. This state farm employs 40 people. There are 12 buildings for laying hens. The farm has mechanical ventilation, feeding, watering, and manure disposal. Most eggs are gathered and processed manually.

The 60 percent rate of lay is low and is a matter of concern to the farm management. Daily egg production is 7000 kg. The feed is manufactured elsewhere and is delivered to the farm. Ingredients include corn, soybean meal, vitamins, and minerals. Sorghum and barley are also used as energy sources. Layers receive a 6:1 Ca:P ratio, whereas brooders and replacements receive a 2:1 ratio.

These Leghorns (originally from Romania) have a 93 percent survival in the brooder and a 97 percent survival in the replacement buildings. The major loss in the baby chicks is from salmonellosis. Later in life, the major disease is coryza. At 1 day of age, the chicks are vaccinated against Marek's disease with the turkey herpes virus strain. At 10 days of age, they receive an aerosol Newcastle vaccine. Chronic respiratory disease is not a major problem.

The chicks receive 8 hours of light per day until 140 days of age. At that time, they weigh 1300 to 1400 gm and are just beginning to lay. They are moved into the vacated, cleaned, disinfected layer house. The disinfectant is formaldehyde, and the house lies empty at least 10 days before receiving the new birds.

In the laying house the birds are started on 14 hours of light. They reach 50 percent production at 162 days of age. Near the end of production, light is increased to 16 hours. Buildings are completed depopulated after 1 year of lay. There is no forced molting.

Only one team member was permitted to enter any of the buildings. Disease security seemed satisfactory. The member, although not a poultry expert, thought that the caged layers looked smaller than desirable and that feather loss was excessive. There were four layers per cage and three tiers of cages. Air quality seemed excellent. The ambient conditions outside were also excellent. The air intakes were in the roof and the exhaust fans in the sidewalls.

The farm veterinarian had a small laboratory to conduct some bacterial and histological tests. Additional diagnostic support is available through a laboratory in Beijing.

Research information reaches the farm through Chinese research institutions and publications, especially the Chinese Academy of Agricultural Sciences; through the Veterinary Research Institute in Harbin; and from foreign friends and literature. There is also a Beijing Association of Animal Husbandry which provides periodic seminars.

Double Bridge People's Commune

The Double Bridge People's Commune, located outside of Beijing, was built in 1958. It covers 90 $km^2$, of which 3600 ha are arable. It has 9000 households, consisting of 42,000 people living in 46 villages. There are six production brigades and 62 production teams. The commune has 15,000 students in 19 primary school (grades 1 to 5) and 6 middle schools (grades 6 to 10). About 20 to 30 students per year have entered the universities over the past 4 to 5 years. The

commune has one 50-bed hospital and several small health clinics at the brigade and production level. Medical care costs 1 yuan per year. This commune was mainly agricultural, producing wheat, rice, fruit, vegetables, dairy, pigs, ducks, and fish. They also had small manufacturing plants for pesticide production and wheat milling, as well as small workshops for agricultural machinery repairing. The following products were sold to the Beijing area:

| | |
|---|---|
| Fresh vegetables | 80,000 kg per day |
| Fresh fruit | 2,500 kg per year |
| Fresh milk | 10,000 kg per day |
| Fresh fish | 80,000 kg per year |
| Market pigs | 15,000 per year |
| Beijing ducks | 60,000 per year |

This commune had 200 walking tractors, 60 tractors (30 to 80 HP), 16 combines, 160 transplanting machines, 90 trucks, and 3000 horses; but most of the work was done by manual labor. Each brigade had one crop test station to breed new crops and to train technicians.

The team visited the Beijing duck farm and the pig farm of the commune. The duck farm had 1500 breeding ducks that produced 1200 to 2000 eggs for a hatch every 6 days. The Chinese candle the eggs at the 6th day and find 85 percent fertilization. They incubate 37.5° C for 28 days and get 87 to 88 percent to hatch. The ducks are sold at 62 days of age and at about 3 kg body weight. Their diet consists of corn and sorghum. Beginning at 50 days of age (about 1.5 kg body

weight), they are force fed four times per day, beginning with 100 gm of food per feeding and increasing to 400 gm of food per feeding. Their average daily gain during this force-feeding period was 100 gm. Mortality was 3 percent in baby ducks, 2 percent in growing ducks, and 4 percent in the force-fed ducks. The Chinese indicated that they had no disease problem and they did not vaccinate for any disease.

The pig farm consisted of 300 sows and 28 boars. The females are Beijing Black (developed by a four-way cross of Russian White, Yorkshire, Berkshire, and native swine). They averaged 11.5 pigs per litter, with two litters per year produced. Their conception rate is 95 percent with natural service and 78 percent with AI (25 percent of the sows are bred by AI). Pig loss is 2 percent at birth, 5 percent to weaning, and 1 percent from weaning to finishing. The Chinese wean at 60 days of age but are trying to wean at 30 to 35 days. Their pigs reach 90 to 100 kg at 225 days of age. The pig feed consists of concentrate and silage or green fodder. The concentrate contains corn, sorghum, wheat bran, barley, and soybean meal and is limit fed at the rate of 2.25 kg per day to sows and 2.5 kg per day to boars. The silage consists mainly of barley, sweet potato stems and leaves, and corn stalks. Green fodder is primarily comfrey. The Chinese used by-products of the noodle factory and therefore did not need to use distiller's grain for feeding. The Chinese did not indicate any disease problem, but do routinely vaccinate against swine fever.

Control Institute of Veterinary, Biological and Pharmaceutical Products

The Institute was established in 1952 by the Ministry of Agriculture and now has a staff of 230. The staff is involved in quality control of vaccines, drugs, and herbal medicines. Additionally, much research is being done to improve or develop biologics and pharmaceuticals. Although the laboratories are scattered in older facilities built by the Japanese, new facilities are being constructed. Of the three major sections in the institute, two are devoted to bacterial diseases and the third to virological diseases.

Bacteriologic laboratory No. 1 is concerned with swine erysipelas, pasteurellosis, anthrax, anaerobes, and enterobacteria, particularly those bacteria involving cattle, sheep, goats, and camels. Bacteriologic laboratory No. 2 is concerned with brucellosis, paratuberculosis, glanders, tuberculosis, salmonellosis, and other zoonoses.

The virological laboratory is primarily concerned with viral diseases and mycoplasma of swine, sheep, and poultry. These control laboratories examine manufacturing plants for efficacy, sanitation, and production procedures but do not routinely receive samples from the biological factories. Herbs for traditional Chinese medicine are collected and analyzed.

Major pig diseases are cholera, erysipelas, pasteurellosis, paratyphoid, and mycoplasmosis. The delegation noted that this insitute does not work with foot-and-mouth disease (FMD) vaccine or seedstock. Such work is done at another facility in northwest China. Rinderpest was eradicated in 1955, but vaccination along

the borders with India, Tibet, and Nepal is continued for yak and cattle every 4 years. Sheep pox is under control, but vaccines with a chick-embryo origin and a lamb-testicle origin are used in Inner Mongolia. An attenuated-virus vaccine is being used to control Japanese B encelphalomyelitis in horses. Pseudorabies in cattle has become a problem in Fujian Province, but is only sporadic in swine.

African swine fever has not been reported in the People's Republic of China. However, swine fever (hog cholera) continues to be a major problem. The swine fever virus vaccine is produced in primary pig kindey cells and also in rabbit spleens. About 500 million doses of swine fever vaccine are produced annually. The Chinese report that the vaccine is 95 percent effective. About 60 to 70 percent of the 130 million pigs are vaccinated for swine fever. The institute has developed an enzyme-linked immunosorbent assay (ELISA) test for this disease. The Control Institute also supplies virulent virus for research to universities, as well as seedstock to the various provinces. Each province has one facility for vaccine production. About 5 percent of the vaccines produced are rejected because of high moisture content or contamination. Baby pigs, fluorescent antibody (FA), and Vero cells tests are used to check for contamination.

Chinese pigs appear to be more susceptible to mycoplasmosis than American pigs. The Chinese have difficulty cultivating strains of Mycoplasma hyopneumoniae. They have attempted to develop an attenuated vaccine for this disease by passing the strain through over 600 passages in baby rabbits. However, the

organism was still pathogenic for swine. Additional studies included 300 passages through chick embryos, but the strain was still pathogenic for swine. The Chinese have attempted to use a microagglutination test with some success. Fluorescent antibody tests were not satisfactory because of low levels of antibody.

Avian vaccines controlled by the virological laboratory include avian infectious bronchitis, Newcastle, Marek's, laryngotracheitis, and Gumboro. Newcastle remains the number one poultry disease in the People's Republic of China. Vaccine failures are often associated with improper handling of vaccine for use on backyard flocks. An ELISA test has been developed for laryngotracheitis. Rabies in sheep in the northwest is a problem, and a low-egg-passage rabies vaccine is used to control the disease.

Bacteriologic laboratory No. 2 is controlling vaccines for brucellosis, glanders, tuberculosis, and leptospirosis. Test antigens are produced for diagnosis. Both a complement-fixation and an agglutination antigen are prepared for brucellosis.

Two new brucella vaccines have been prepared -- a Brucella suis #2 vaccine and a Brucella melitensis #5 vaccine. They are administered to cattle and pigs orally, in the feed or drinking water, or by aerosol. They are "naturally" attenuated from selected stock cultures. They are claimed to be safe and stable, providing 75 percent protection for cattle and yak and up to 80 percent protection for sheep, goats, and swine. The Chinese are now vaccinating annually but have shown that immunity lasts up to 2 years. The vaccine is claimed to be safe for use on pregnant animals. Oral vaccination results in seroagglutination

titers of 1:400, whereas inoculation results in titers that range generally from 1:1600 to 1:3200. Immunological studies on strain 45/20 vaccine are not satisfactory. The Bejing area was reportedly free of both brucellosis and tuberculosis.

Bacteriologic laboratory No. 1 produced a number of biologics, including Escherichi coli pili bacterin, Salmonella paratyphi for pigs, Salmonella pullorum, and Salmonella abortus-equi. Colibacillosis was reported to be a serious problem in pigs up to 10 weeks. A K88 antigen was produced. Kohler's bacterin had been tried at other locations but not at this institute.

The institute was also conducting serological analysis of pigs for erysipelas. A bacterin has been prepared, with aluminum hydroxide as adjuvant. It has been field tested and proved safe and effective. As a result of vaccination, erysipelas is now under control. An attenuated vaccine with a smaller dose has been developed but is less effective.

Streptococcal Group C infections in swine are a serious problem resulting in meningitis and septicemia. However, the Chinese did not consider mastitis, Metritis agalactae, a problem.

Pasteyrellosis was identified as a serious problem in swine and poultry. Attenuated- and killed-bacteria vaccines with adjuvant virus have been developed. Acute pasteurellosis Type B is the most prevalent type in pigs. Types A and D are also causes of pig diseases. Type B is highly transmissible, whereas Types A and D are sporadic. Vaccines are of limited value, and immunity lasts less than 3 months. Pasteurella bacterins have not been incorporated into the anaerobic clostridial bacterins (perfringens, chauvei, septicun).

The Chinese are producing a bivalent anthrax spore vaccine, but we did not enter the production laboratory. The laboratory has developed a bacterial fermentor unit and is producing cultures of E. coli and Clostridium perfringens. It is producing a bivalent anthrax spore vaccine as well as a leptospira bacterin (with adjuvant).

Scholarly Discussions at Beijing

History of Veterinary Medicine in the People's Republic of China. The most serious animal disease problems were rinderpest, clostridial infections, anthrax, contagious bovine pleuro-pneumonia, and swine fever. Vaccination is the most common method, along with isolation procedures for disease control. These have controlled foot-and-mouth disease. The government has organized commissions in each county for disease prevention.

In the control of rinderpest, a lapinized attenuated vaccine for rinderpest was used initially, but this vaccine was discarded because of variability in susceptibility and immune response. Caprinized and ovinized vaccines for rinderpest in Korean cattle and yak were simultaneously used. The government relied on the local people to make and use the vaccine on the spot. It was a low-cost product and provided good immunity of adequate duration. This process led to the eradication of rinderpest in 1955.

Foot-and-Mouth Disease. The disease was prevalent before 1949 and was again introduced from Russia in 1958. The cattle were isolated and slaughtered in Shanghai. Disinfection procedures were begun. Vaccines were not available, so saliva and material from infected animals were used for inoculation. In 1962, FMD was reintroduced from Russia into Mongolia. The Chinese vaccinated a belt of cattle to prevent its spread. The vaccines used were inactivated and attenuated, and the disease was eradicated along the border. In 1965, both Russia and Mongolia experienced outbreaks of FMD, so China adopted some active measures. Animals were drawn back from the border and then vaccinated to prevent FMD from entering the People's Republic of China. The People's Republic of China still vaccinates animals along the border.

Brucellosis. This disease still exists in northwest China in the pasture areas. Infected animals are isolated, and attempts are made to reproduce healthy herds. Formerly, Strain 19 vaccine was used; now, two new vaccines have been developed. These attenuated vaccines are Strain B-2 *B. suis* and B-5 *B. melitensis*. The Chinese believe that both of these vaccines are better than Strain 19. The vaccines are generally administered in aerosols, as a dust in the feed, or in water (orally). In Xinjiang, the dusting method is used, and the incidence of brucellosis in sheep has decreased sharply. The large dairies near the big cities are reportedly free of brucellosis. This is of major zoonotic importance.

Other Disease Control. An aluminum hydroxide adjuvant was used for erysipelas vaccines. Since 1965, an attenuated vaccine

has been used, and since 1974, a bivalent vaccine for swine has been prepared with erysipelas and Pasteurella strains. This attenuated vaccine is administered orally.

The mesogenic Strain 1 (Hitchner) vaccine for Newcastle disease is used. The Chinese rely mainly on backyard raising of chickens, and if an outbreak occurs in a flock, the chickens can readily be slaughtered. This disease occurs rather sporadically.

The Chinese scientists have not yet developed effective vaccines for fowl cholera or avian mycoplasmosis.

Glanders is under control; the mallein test is used, and infected animals are slaughtered.

Quarantine Measures in the People's Republic of China. There are 36 quarantine stations located at major airports, train stations, and highway entry points from foreign countries. There are 190 veterinarians in charge of animals and animal products importation. Every animal to be imported is quarantined for 60 days; certificates are checked when issued by foreign countries. In the absence of any clinical disease, the animals are examined serologically, pathologically, and bacteriologically. If all these tests and examinations are negative, the animals may be shipped to their desinations. They are isolated for 1 year. If they pass all tests and examinations at the end of 1 year, they may quality for breeding with native animals. Generally, all animals must come from areas free of certain diseases, and they must appear healthy. An importer of a foreign breed must obtain approval from and agree to sign a contract with the Chinese Ministry of Agriculture.

The Chinese indicated that their country does not have bluetongue, Infectious Bovine Rhinotraceitis (IBR), Bovine Viral Diarrhea (BVD), African Swine Fever (ASF), African horse sickness, FMD, swine vesicular disease, and fowl pest. If the Ministry of Agriculture finds any of the above in the animals imported into the People's Republic of China, they will slaughter the animals and request compensation from the exporting government. Similar requirements apply to products from animals in foreign countries. If the products are from a disease-free area, the import request must also designate a specific port and a specific factory. It is absolutely forbidden to import from countries where ASF exists or is suspected.

Research Organization. Several institutes are under the direction of the Chinese Academy of Agricultural Sciences in the Ministry of Agriculture. These include: Research Institutes of Animal Sciences at Beijing and at Lanzhou, Harbin and Lanzhou Veterinary Medical Research Institutes, and the Lanzhou Research Institute of Traditional Veterinary Science. The Control Institute of Veterinary Biological and Pharmaceuticals (Beijing) is at the same level as the Chinese Academy of Agricultural Sciences. Other institues include the Schistosomiasis Research Institute in Shanghai, the Research Institute of Grassland and the Research Institute of Cepiculture in.

All of the above institutes have nationwide significance and responsibility. They are directly under the supervision of the Ministry of Agriculture. Some biofactories are located in each province.

Organization of Veterinary Medicine. The organization of Veterinary Medicine was as follows:

Central Government
Ministry of Agriculture
General Bureau of Animal Husbandry
Division of Veterinary Medicine
a. Quarantine
c. Animal hygiene.
b. Prevention

Each province, municipality, and autonomous region has a bureau of animal husbandry. Each has an institute of animal husbandry and veterinary science. Diagnostic laboratories and quarantine stations are at the prefecture and commune level. At some of the units there are animal breeding stations and animal hospitals. At the brigade level, there are a "barefoot veterinarian," an artificial inseminator, and a vaccinator.

Education. There are seven universities or agricultural colleges under the Ministry of Agriculture. Each province has an agricultural college and a department of animal science. There is some veterinary training at the high school level for vaccinators, barefoot veterinarians, and artificial inseminators.

Swine Breeding in the People's Republic of China. The Chinese indicated that there are over 100 native breeds used in swine production in the People's Republic of China. The name, location, and description of the 11 most important native breeds as indicated by this group are as follows, listed in order of importance:

| Name | Location | Description |
|---|---|---|
| Tai Lake | Shanghai | Black in outside, gray when inside |
| Neijiang | Sichuan | Black |
| Rongchang | Sichuan | White with black eye patches |
| Ming | Heilongjiang | Black |
| Jinhua | Jiangsu | White body; black head, neck, tail |
| Dahuabai | Guangdong | White with large black spots |
| Luchuan | Guangxi | Black back, white underline |
| Ninxiang | Hunan | Black with white spots |
| Jianquahai | Shanghai | Black |
| Little Ear | Yunnan | Black; white nose, feet, tail |
| Huai | Fujian | Black. |

The Tai Lake is the most widely used native breed. The Chinese reported that it produced an average of 15 pigs per litter. Puberty is at 4.5 months of age, and the first litter is farrowed at 10 months of age. The Chinese indicated that the Ming averaged 16 pigs per year.

Several new "synthetic" breeds of pigs have been developed recently in the People's Republic of China and are the breeds most commonly used in commercial production. The most important new breeds, and their original composition and location of development are as follows:

| New breed | Location of Development | Breed Composition ("Old Breeds") |
|---|---|---|
| Beijing Black | Beijing | Russian White, Middle Yorkshire, Berkshire, Ming |
| Harbin White | Harbin | Middle and Large Yorkshire, Ming |
| New Huar (black) | Jingsu | Middle Yorkshire, Ming |
| Shanghai White | Shanghai | Berkshire, Middle Yorkshire, Hampshire, Tai Lake |
| Hili White | Xinjiang | Russian Large White, Ming |

The non-native "old" breeds used in the development of these breeds had been imported in the 1920's: Yorkshire from England; Landrace from Japan, Sweden, and France; and Hampshire from the United States. The Chinese indicated that Duroc and Landrace were imported in 1979. They did not indicate the origin of the Berkshire.

Most of the sows in the People's Republic of China are located on state or commune farms. However, many pigs are purchased and fattened by individual families. The government provides 0.2 ha (0.5 acre) for each sow or fattening pig. When the commune member sells the pig to the state, he is allowed 1 kg of concentrate for each kg of pig sold. For each piglet, he receives 5 kg of concentrate; and for each fattening pig, he receives 25 to 50 kg of concentrate.

Under the auspices of the Chinese Academy of Agricultural Sciences, the Beijing Research Institute of Animal Science is studying the effect of energy and protein level during gestation and lactation on reproductive performance of swine. For research they have a herd with 120 sows and 10 boars.

The Beijing Black was developed according to the following procedure. After the initial crossing, the population was intermated. The population consisted of 40 females and 9 males for each generation. Generations were turned over annually. One of every 20 boars and one of every 4 females were selected. Selection was in three stages. The first selection, at 2 months, was based on the dams' reproduction (between-family selection). At 6 months, individuals were selected on growth rate and back fat (within-family selection). At mating, selection was based on general type. The Berkshire is responsible for 20 to 25 percent of the genetic background of the Beijing Black. At this time, the Chinese are not certain of the reproductive characteristics in the Beijing Black and are therefore studying the anatomy, histology, and morphology of the reproductive system.

## HARBIN, MAY 26 - JUNE 1

Harbin is a city of 3 million people and the capital city of Heilongjiang Province. It borders on Siberia on the north and has a latitude similar to that of Minnesota. The province contains 75 counties and municipalities, 33 million people, and 8 million ha of land. Winters are severe, with temperatures

reaching -40° C. In summer, the maximum is 36 to 38° C, with an annual average temperature of 4 to 6° C. The frost-free season is 120 days and annual rainfall is 550 mm (60 percent from June through August). The province has five major regions: pasture, semi-pastoral, agricultural, forest and mountains, and suburb zones.

The livestock population in 1978 was as follows: 7.98 million pigs, 1.07 million cattle, 2.45 million sheep and goats (mostly sheep), 1.55 million horses, 40 million poultry, and 60,000 deer. There are four major breeds of swine: Harbin White, black-and-white, Shanghai White, and Da Ming (black). These may be crossbred with the Long White or Soviet Landrace type originally from Sweden.

Provincial Animal Breeding Service Center

The Provincial Animal Breeding Service Center was designed in 1975, and construction began in 1976. The center currently has 121 staff members, 40 of whom are technical personnel.

The center was established to care for the AI bulls, produce semen for the whole province, produce liquid nitrogen for widespread use, register all cattle in the province, conduct progeny tests, and conduct seminars on AI technique.

The center currently houses 70 bulls, including 13 Charolais, 15 Limousin, 3 Hereford, 1 Angus, 16 Simmental, 1 Shorthorn, and 21 black and white. The Charolais were imported from France and West Germany, the Limousin from France, the Herefore and Shorthorn from England, the Angus from New Zealand, and the Simmental from Austria and West Germany.

During the first 5 years of operation, this center produced 3.5 million doses of semen; 430,000 cows were inseminated and 250,000 offspring have been produced. In 1980, they planned to produce 1.2 million doses of semen and 150,000 $m^3$ of liquid nitrogen. The liquid nitrogen is produced with homemade machines, a Phillips 430 and a Phillips 106. Most of the semen is frozen in pellet form, but the Chinese are changing to straw production. Sixty percent of dairy cattle and 40 percent of yellow cattle in the province are inseminated with frozen semen.

The Chinese check for pregnancy by 30-day nonreturn and rectal palpation. The conception rate at first service is 45 percent for yellow cattle and 60 percent for dairy cattle. The conception rate for a year is 70 percent for yellow cattle and 93 percent for dairy cattle. The difference in conception rate between yellow cattle and dariy cattle is due to the poorer environment in which yellow cattle are kept. The Chinese are inseminating 10 million sperm per insemination. They report no evidence for variation in conception rate among bulls. They report the use of some pregnant mare serum (PMS) for estrus synchronization but very little use of prostaglandins.

Bulls are given a bacteria test and physical examination and must be free of tuberculosis and brucellosis before entering the station. The bulls are not vaccinated in the AI center. The Chinese also stated that they submitted samples for viral examination. Bulls are culled from the stud for poor semen, age, or injury.

Selection is based primarily on a progeny test; however, individual, half-sib, and parental information is also used.

The traits stressed in dairy cattle are quantity of milk, percentage of butter fat, and conformation. The traits stressed in beef cattle are birth weight, 6-month body weight, yearling weight, and average daily gain. In general, this station is operated similarly to the one in Beijing, but this station is much better equipped and staffed.

Xiangfang State Farm

The Xiangfang State Farm is located about 10 km east of Harbin. Established in 1949, the farm has a staff of 1700 people. There are 1000 ha of cultivated land that is used for production of grain (including rice), oil plants, and animal feed (corn silage, pumpkin, carrot, and millet).

The farm has always stressed animal agriculture. It has 460 black-and-white cattle (Holstein), 500 producing brood sows, and a swine feed lot (about 6000 pigs per year). The farm also has several industrial enterprises, including small machinery repair, brickmaking, a grain factory, a wool plant, a brewery, and a construction team. The farm also has a middle school and a hospital.

Swine Breeding Units. The main objectives of the swine breeding units are to propagate the Harbin White breed for use as breeding animals on other state farms and communes and to evaluate the performance of several crossbreeding programs. The farm produces about 2000 piglets (sold primarily for breeding) and about 6000 fattening hogs annually. The Chinese listed the main advantages for the Harbin White breed as: high sow productivity, roughage tolerance, high adaptability to the area,

high average daily gain, and good feed conversion. Over 100,000 Harbin White have been sold to other farms for breeding since 1949. The Harbin White is very similar to the American Yorkshire. Some with drooping ears appear to be a cross between Yorkshire and Landrace, but the drooping ears may still go back to the native Ming that has been upgraded to the present Harbin White. The Harbin White on this farm were medium-framed, with adequate length and depth, good underlines, and sound feet and legs. Lateral milk veins were evident in several females in late gestation, indicating good milk production. Lean-to-fat ratio was similar to that of the average American Yorkshire.

The unit is evaluating several two-breed crosses and two three-breed crossing systems. The two-breed crosses being studied include: Ming x Harbin White, Russian Long White (Landrace) x Harbin White, and Tai Lake (from Shanghai) x Harbin White. The Tai Lake is recognized as the most prolific breed in the People's Republic of China (14 to 16 pigs per litter). They are a black breed with heavy, drooping ears. As a breed, they are small to medium-framed, with little evidence of muscling, but with extremely productive underlines. We saw one litter of 16 (about 4 weeks old), but numbers in the farrowing house ranged generally from 9 to 12. In one of the two three-breed systems under study, the Damen (Large Ming) is crossed with the Harbin White to give the $F_1$, which is then bred to the Long White. In the second system, Tai Lake x Harbin White gives the $F_1$, which is bred to the Long White. The Chinese hesitated to evaluate the crosses at this early date, but said the crossbred sows farrowed one or two more live pigs per litter than the two-

breed crosses (14 versus 12 to 13). They appeared to show most interest in the Ming x Harbin White, which they indicated had the following average performance levels: live pigs farrowed - 12, birth weight - 1.2 kg, number weaned - 10, weaning weight at 2 months - 16 kg. Observation of litters in the farrowing house indicated that the cross was larger-framed than the Ming, with a higher growth rate, more muscle, and less fat.

The feeding program during gestation was: 3 kg corn silage, 3 kg brewers' grain, and 1 to 1.5 kg concentrate per day. During lactation, the Chinese continue feeding the same level of corn silage and brewers' grain but increase the concentrates to 3 to 3.5 kg per day. Creep feed (offered at 7 days) was very finely ground and consisted of about 50 percent corn, 20 percent sorghum, 20 percent pressed soybean cake, and 10 percent other feeds (for example, hay flour, wheat, or rye bran). They indicated that, when possible, they included a little (up to 3 percent) fish meal in the diet.

The Chinese reported 2.1 litters per sow per year (maximum with 60-day weaning), 2 percent stillbirth deaths, and 94 percent weaned (in relation to live pigs farrowed). Sows are normally kept for 10 litters and culled before stillbirths get too high. Farrowing pens were about 3 x 3 m with solid sidewalls and no guard rails, although there was a protected area for creep feed. Floors were bedded with fresh straw placed in one corner. Pigs receive 24-hour personal care, which makes the high survival rate possible. Pigs were free from obvious diarrhea, sneezing, coughing, lice, knee abrasions, and facial lacerations. Tails and needle teeth appeared to be intact. We saw no downer sows

despite long lactation periods and big litters. Major problems reported in the farrowing houses were paralysis of the pig at birth and anemia-associated diarrhea.

Swine Finishing Operation. A large-scale confinement operation was established in 1973. The building that the group visited was a two-story, partly slotted concrete-floored facility in which about 600 hogs could be finished at one time (about 30 to 40 pigs per pen). Pen layout, environment, and health appeared very good. The air was fresh, with little odor. There was no sneezing or coughing, although some mange and sore feet were evident.

The only feed being offered was a concentrate: about 50 to 60 percent ground corn, 15 to 20 percent pressed soybean cake, and 25 percent bran (wheat, rye, corn) plus minerals and vitamins. The feed was distributed through a chain-drag conveyor. The Chinese indicated that pigs received forage feeds (for example, carrots, pumpkins) "in season," but none were being fed during our visit. They reported an average daily gain from weaning to market (at 90 kg) of 500 gm and a feed conversion ratio of 4:1. The lean-to-fat ratio of the pigs was very poor. Although a few would grade No. 1 (they appeared to be Harbin White or Harbin White x Long White crosses), most of the pigs would grade 2, 3, or 4, with about an equal percentage in each grade. The Tai Lake x Harbin White cross had excess fat and poor muscle development.

The feed-mixing facilities for the farm consisted of a large room about 9 x 18 m containing several piles of ground feed ingredients (corn, rye bran, wheat bran, ground soybean

cake) plus whole corn (extremely hard and flinty, nearly round), and pressed soybean cake. A proportional feed grinder and pellet mill were in the room, but both were inoperative. Apparently, all food was mixed on the concrete floor with scoops. The corn silage, brewers' grain, and concentrates for the lactating sows were hand-mixed in one pen at the end of each farrowing building.

Dairy Unit. At present, 240 black-and-white cattle are used for milk production. About 100 heifer calves are retained as possible replacements and are housed in outside pens (20 to 25 per pen). The bull calves are sent to another farm for raising. A 99 percent survival rate was reported for the heifer calves.

The Chinese indicated that the 240-cow milking herd produced 1.3 million kg of milk annually (5400 kg of milk per cow per year). The cows were being fed good-quality corn silage and shredded sugarbeets. During the day, the cows were provided a native grass hay (sheep grass) that was similar to good quality little bluestem hay cut in eary maturity and cured properly. The Chinese indicated that this was the best quality sheep and cattle hay available in the People's Republic of China.

Cows were milked three times per day (7:00 a.m., 2:00 p.m., and 7:00 p.m.), and the "fresh" cows were milked one more time, near midnight. The Chinese reported only a small incidence of mastitis, and several of our group believed that this was because of the frequency of hand milking. Cows were vaccinated once a year for foot-and-mouth disease, brucellosis (ovine 5 injectable), and anthrax. They test for tuberculosis twice a year.

The 115-day mean interval from calving to successful mating was "too high" to satisfy the manager, and he indicated that this was one of their main problems. A veterinarian stationed on the farm was responsible for sanitation and treatment of sick animals. The AI technician was responsible for pregnancy determination.

Harbin Veterinary Research Institute

The Harbin Veterinary Research Institute was started in 1948. It has been recognized and rewarded several times for its important research by the Chinese Academy of Agricultural Sciences and by the national and provincial governments. The institute's accomplishments include the identification of the causes of white muscle disease and osteoporosis, and the production of an attenuated rinderpest vaccine, a vaccine against contagious bovine pleuropneumonia and an avianized sheep pox vaccine. Institute researchers have used oxytetracycline to treat glanders and sulfa drugs to treat coccidiosis and pullorum. They have developed inspection and quarantine methods and have promulgated meat inspection programs. They are studying the pathogenesis of various diseases by use of radioisotopes and electron micros- copy. They have trained over 100 scientists, who are in all parts of the People's Republic of China and throughout the world.

The institute is under the control of the Chinese Academy of Agricultural Sciences. It has a staff of 520 personnel, 185 of whom are scientists, including 106 with higher education. Most of the staff have graduated since 1949. Most have 20 to 30 years of service.

The institute has 22 research projects; of these, 10 are assigned by the central government and 12 are selected by the institute. The 10 assignrd research projects are as follows:

1. Immunology of equine infectious anemia
2. Diagnosis of transmissible gastroenteritis of swine
3. Diagnosis and immunology of atrophic rhinitis
4. Immunology of bovine ephemeral fever
5. Development of a flock of specific pathogen-free (SPF) chickens
6. Brucellosis immunology
7. Quick diagnosis of animal diseases and rapid disinfection
8. Toxoplasmosis of swine
9. Avian infectious bronchitis
10. Mechanism of immunity and genetics of resistance to disease agents.

The institute's equipment list is quite impressive; it includes an electron microscope, ultracentrifuge, and ultraviolet spectrophotometer, but there is still a need to update much inadequate equipment. The library has 40,000 books for reference and subscribes to 470 journals, many of which are U.S. and Canadian. The institute still does not meet the requirements of the central government.

The Viral Diseases of Swine Laboratory has 22 employees. Research is conducted on transmissible gastroenteritis (TGE), pseudorabies, and the areosol administration of swine fever vaccine, including fluorescent antibody techniques. The researchers use biopsy of swine tissues from tonsil, small intestine, and mesenteric lymph nodes for diagnosis. The swine fever virus has been propagated on thyroid cells and embryonic

swine kidney cells. The researchers have passaged the virus 50 times in such cells, but it is still too virulent for use as a vaccine for young pigs. Pseudorabies occurs only sporadically and is studied by this laboratory.

The Bacterial Diseases of Swine Laboratory has 15 employees who are doing research on atrophic rhinitis (Bordetella bronchiseptica) and have developed an agglutination test. They are also working in colibacillosis.

The Viral Diseases of Poultry Laboratory has 16 employees. Research is conducted on four major diseases: Marek's, Newcastle, fowl cholera, and avian bronchitis. The introduction of five breeds of chickens from France resulted in the importation of Marek's disease. The turkey herpes virus vaccine F-126 was imported and has been effective in the People's Republic of China. An agar-gel precipitin test has been developed, and a skin antigen and cell cultures are used. The test is highly sensitive and is similar to the British antigen test. The researchers are also working on an attenuated Marek's vaccine.

The researchers have developed a combined Newcastle and fowl cholera attenuated vaccine. It produces no harmful reactions and no loss in egg production, and the immunity lasts 2 to 3 months. If aerosol vaccination is used, immunity may last up to 4 months. The researchers are also trying to select new strains of fowl cholera to enhance vaccine immunogenicity.

They have studied avian bronchitis strains in the past and found that the strains imported from The Netherlands were more resistant than the Chinese strains. Vaccines H-152 and H-120 (attenuated) protect against the virulent Chinese strains.

The Bacterial Diseases of Poultry Labortory has 19 employees. Research is conducted on diagnosis and immunity of chronic respiratory disease (CRD) with Chinese strains and the international strain 6. Results of studies with Chinese and French vaccines have been unsatisfactory. They have studied Japanese and American strains of Mycoplasma gallisepticum and Mycoplasma synoviae.

Research is also being conducted in this institute on laryngotracheitis, infectious rhinitis (Hemophilus), and infectious encephalomyelitis.

The Diseases of Economic Animals Laboratory has a staff of 19 people. They started research in 1979 on mink distemper vaccine. A virulent strain was isolated and attenuated in chick embryos (desiccated). Seroconversion rates have been good, but the duration of immunity is unknown. When the virus is passaged in dogs, its virulence is increased, but signs in mink are less apparent. This laboratory has also done research on ephemeral fever, bovine leukosis, and Aleutian disease of mink.

The Zoonosis Laboratory has a staff of 22 employees. Research is being conducted on preparation of an attenuated vaccine for brucellosis. From laboratory and field studies, the Chinese scientists claim that the vaccine is effective for cattle. The vaccine is also effective for sheep and goats, but not for swine.

Research on toxoplasmosis has resulted in development of an agar-gel diffusion test for use on adult swine. Recently, research has been begun on leptospirosis.,

The Equine Infectious Anemia (EIA) Laboratory has 23 employees, including 12 scientists, 6 technicians, and 5 animal caretakers. They are studying the humoral and cell mediated immune responses to EIA for the purpose of developing an effective EIA vaccine. They are also working on new diagnostic assays for detecting EIA infected horses. Laboratory tests routinely used for EIA studies include complement fixation, cytopathic effect (CPE) in donkey leukocyte culture (DLC), horse (or donkey) inoculation, agar gel immunodiffusion (ID), and the enzyme linked immunosorbent assay (ELISA). Electron microscopy is also available for morphological studies. However, fluorescent antibody is not routinely used for EIA viral detection. The immunodiffusion test used at Harbin was designed after the Coggins method.*

The Quick Diagnosis and Disinfection Laboratory conducts research on pesticides, herbicides, and their residues in the body. Efforts are directed toward imported animals and their products. Research is conducted also on the diagnosis of anthrax, brucellosis, and on fluorescent antibody (FA) and ELISA tests. Disinfection by radiation, aimed at the Brucella organism, is also being studied.

The Pathology Laboratory has 19 staff members. Research includes that on the morphology of equine infectious anemia (EIA) virus, electron microscopic and FA studies, histochemistry, ELISA, and research into the pathogenesis of diseases. Cellular and humoral immunity studies are in progress.

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*For further information on EIA, see Appendix 1.

The Biophysics Laboratory has nine employees who conduct research on the nature, morphology, and purification of the sarcoma (leukosis) virus of fowls. They do survey work for the incidence of the group specific antigen in flocks of fowls. This study has only begun, so there are no major results at this time.

The Biochemistry Laboratory has seven employees. They conduct research on the mechanisms of immunity in domestic animals and lipopolysaccharides and on the genetic variation of the etiological agents. Some studies involve the DNA of the swine erysipelas bacterium and its transfer by enzymes to recombine in vitro with E. coli. This research is being done jointly with scientists at Shanghai University.

The institute also conducts studies on colibacillosis of swine. The researchers indicated that their most common E. coli antigens were K:78, K:88 and 0:8, 0:138 and 0:141.

They are also using an agglutination test for Bordetella bronchiseptica, which they believe is the sole cause of atropic rhinitis. They have also used the complement-fixation test and the nasal swab method. Pigs are tested 1 month after birth. However, the researchers indicated that the test is used mainly for imported pigs, and the local incidence of the disease is unknown. Diagnosis of atrophic rhinitis was based on the agglutination test, the isolation of Bordetella, and the lesions observed at slaughter.

The researchers indicated that transmissible gastroenteritis (TGE) exists in some provinces, but the incidence is low. They use a tonsil gun for obtaining biopsy material on live pigs. The tool seemed to work very well.

The Chinese believe that they imported atrophic rhinitis, swine dysentery (bloody diarrhea), and ephemeral fever of cattle in recent years through introduction of foreign breeds.

The team was taken on a tour of the institute's laboratory animal facilities. The mouse colony was in excellent condition. The Chinese used crock jars with metal screen tops. The crocks could be easily washed and cleaned, then sterilized by flame. The guinea pig cages were wooden boxes with wire sides and tops. Although the boxes were clean, they were inadequate by our sanitation standards. The rabbit cages were large wire cages in good condition and would meet the requirements for space of any animal welfare group. The Chinese reported that no disease problems existed in their animal colonies.

The facilities for housing experimental animals for research on EIA were clean and sanitary. The horses were in excellent condition; they were in a study on the duration of immunity from EIA vaccine and would be challenged later in the summer. The number of animal caretakers and workers in the facility was adequate.

The team members were told that each province had a diagnostic laboratory, as do most counties. The problems that cannot be handled at the county and provincial level are handled by Harbin's several research laboratories. Veterinary information was supplied by Chinese journals and scientific societies, including the Chinese National Society of Agricultural Sciences, the Chinese National Society of Veterinary Sciences, the veterinary medicine and animal science societies, and the Journal of Veterinary Science.

Harbin Swine Breeding Farm

The animal science team members visited the Harbin Swine Breeding Farm of the municipality, locaetd about 20 km each of Harbin. The farm was established in 1959. Its main purpose was the breeding and extension of the Harbin White. The Director of the Farm indicated that at least one-half of the swine population in the Heilongjiang Province was Harbin White. The farm has 380 Harbin White females (100 gilts) and 30 boars (20 Harbin White, 4 Landrace, 4 Soviet White, and 1 Russian Spotted). They produce about 5000 piglets annually.

The Harbin White at this farm was developed through the matings of Berkshire and Yorkshire boars to Ming sows. Berkshire and Yorkshire breeds were introduced to the People's Republic of China by Russia and Japan. After Liberation (1949), the Harbin White were further upgraded by use of Large White and Russian White boars. The farm estimated that a large portion (60 percent) of the present Harbin White is Russian White.

The desirable features of the Harbin White are as follows:

1. Dual purpose - both lean and fat. Average back fat is 3 cm (measured just above the shoulder) and maximum back fat is 7 cm. Because of the shortage of vegetable oil, peasants have preferred much fat to use for cooking; but more vegetable oil is becoming available, and there appears to be a desire to reduce fat.

2. Cold resistant. Heilongjiang's temperature ranges from 38° to -40° C.

3. Roughage tolerant - can grow well on high-fiber foods.

4. Good adaptation to local conditions - rugged, do well even with poor management.

Characteristics desired in the Harbin White include the following:

1. Medium-length snout, slightly dished face
2. Upright ear
3. Level top
4. Six to seven pairs of teats
5. Boars - 200 kg at 18 months; gilts - 150 kg at 18 months
6. Body length (from between ears to base of tail): boars - 140 cm; gilts - 130 cm
7. Height at top of shoulders: boars - 80 cm; gilts - 70 cm
8. Purebreds - totally white.

Average litter size for the purebred Harbin White at this farm has been: gilts, 8 farrowed (7 weaned); sows, 10 farrowed (8 to 9 weaned). The breeders recommend breeding at about 9 months of age (90 kg). Gilts have first estrus at 4 to 5 months, but if they are bred at this time (35 to 40 kg body weight), litter size is small, pigs have low birth weight with poor survivability, sows milk poorly, and pigs have a low growth rate.

The fast growers reach 90 kg in 7 months, whereas the slow growers reach 100 kg at 9 months. Crossing the Harbin White with other breeds gives a faster growth rate. The main crosses have been the Harbin White female with either the Ming (best cross) or Landrace boar. The feed conversion ratio is usually 4.5:1, with a dressing percentage of 76 to 78 percent (excluding

four feet and head). Ming or Landrace females crossed with Harbin White boars were reportedly not as good.

The farm began a swine finishing unit in 1980 (1000-head capacity annually). About one-half of the concrete-floored pens were covered with igloo-type houses. The concentrate was fed in a handmade metal feeder, and a long concrete trough held the hand-carried water.

While the farm was familiar with the National Research Council (NRC) Nutrient Requirements of Swine, its feeding program did not meet NRC standards because concentrates are severely restricted, and the swine are fed the products that are available. Feed was short in 1980, and the farm realized that the finishing pigs were not fed concentrate or protein. The concentrate (corn, grain bran, soybean meal) normally supplies about one-third of the dry matter content of the diet. Green fodders or silage (pumpkin, comfrey, sugarbeet pulp, millet) and roughages (dried brewers' grain, bean curd residue) are also fed. The green fodder or silage and roughage feeds are supplied ad libitum. The swine were being fed the following proteins per day:

| Constituent | Gestation | Lactation |
|---|---|---|
| Concentrate | 0.75 kg | 1 kg |
| Green fodder | 10.0 kg | 10 kg |
| or | | |
| Silage | 2.5 to 5.0 kg | 2.5 to 5.0 kg |
| Roughage | 10.0 kg | 10.0 kg (fed four times per day) |

The breeders achieved a conception rate of about 75 percent with AI and 90 to 95 percent with natural service (breeding twice each estrus). The breeders attributed the low conception rate with AI to poor sanitation and semen handling, in addition to limited experience of the inseminator. They also indicated that a boar was not used to check heat.

Breeding animals are routinely vaccinated for hog cholera, erysipelas, salmonella, and paratyphoid. Breeders experience sporadic outbreaks of cholera, paratyphoid, and white scours. The managers reported a few abortions in the first half of pregnancy and few stillbirths and a low incidence of mummies in gilts. The farm had very simple diagnostic facilities and sent most difficult cases to the Harbin Veterinary Institute.

Each caretaker was responsible for about 15 sows, and had several requirements in the farrowing house:

1. Be there and give attention at partutition.
2. Fix a teat for each piglet.
3. Train pig to eat concentrate by 2 weeks of age.
4. Supply ample water for sow and piglets (hand water piglets in pen).
5. Keep house and pigs warm.
6. Keep pens dry and clean.
7. Keep clean environment (both inside and outside of pen and on body of piglet).
8. Take all measures to prevent diarrhea.

The group toured the farm and saw the boars, the gestating and lactating sows, and the finishing unit. The Harbin White boars varied widely in frame size and size for age. Two Ming boars were used for crossbreeding. One Soviet White boar was

large framed, with excellent depth and length, and level topped, with good muscle development. The breeders had just started using the Cumelof (Russian Spotted) for crossbreeding and were encouraged by the results.

Sows were farrowed in open pens with a protected feeding area for the pigs. Two sows and pigs were placed together after the pigs were about 3 days old. To obtain more uniformity of growth during the suckling period, the breeders placed a distinguishing spot on each pig within 24 hours after birth and attempted to get the smaller pigs to nurse the second, third, and fourth nipples from the front. The breeders were also providing iron and copper to the pigs by dissolving crystals in the pigs' water each day. They also provided soil and charcoal to the pigs for the first 10 to 14 days after birth. Pens were well bedded and dry, and pigs were doing as well as could be expected when the nutritional regime of the lactating sow is considered.

The finishing unit was well designed (about one-half of the pen area was covered and enclosed), with a self-feeder for concentrate. Silage was fed four times per day on the concrete floor, and the 3- to 4-month-old pigs appeared to adapt to it well. Evidently the pigs have a pretty slow growth rate for 30 to 60 days postweaning, until they become adapted to the silage or green fodder, which provides one-third or more of the dry matter of the diet.

Yangjiagang State Farm

The Yangjiagang State Farm is a 400 sow-swine farm managed by a former lecturer of Harbin Agricultural College. One hundred fifty of the sows were Harbin White. There were 30 boars housed in the old, original swine facilities. The boars were moved about 100 m to the breeding area. Facilities were typical of the Harbin area: long farrowing and gestation buildings had pens on either side of a center aisle. Farrowing pens had a 10-cm retainer wall to hold the bedding in one corner of the pen.

Several crosses were being tested:

1. Harbin White (M) x Tai Lake (F) -
   $F_1$ (F) x English Landrace (M)*

2. Cumelof (M) x Tai Lake (F) -
   $F_1$ (F) x English Landrace (M)

3. Cumelof (M) x Tai Lake (F) -
   $F_1$ (F) x Cumelof (M)

Cross No. 2 was preferred because of the high litter size, survival, and average daily gain. Cross No. 3 produced a rugged pig with high litter size. The Cumelof is a Russian breed that looks like the U.S. Spot breed.

At the 56th day after farrowing, sow feed is reduced by one-half. At the 56th and 57th days, the pigs are allowed to

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*(M) = Male; (F) = Female.

nurse twice during the day and remain with the sow overnight. At the 58th day, the pigs nurse once during the day; at the 59th day, they are with the sow only at night. Pigs are weaned on the 60th day. On the day of weaning, the 60th day, no feed is given to the sow.

Breeding apparently is concentrated in March through May and September through November. The managers reported 2.1 litters per sow per year. If they try to breed in the summer, the sows are less likely to show estrus immediately after weaning. The following are the approximately daily gestation and lactation rations for the farm, although ingredients vary according to available feedstuffs.

| Ingredient | Gestation | Lactation |
|---|---|---|
| Soybean meal cake | 500 gm | 750 gm |
| Corn | --- | 750 gm |
| Wheat bran | 500 gm | 1500 gm |
| Brewers' grain | 3.0 kg | --- |
| Sugarbeet pulp | 3.0 kg | 3.0 kg |
| Corn silage | 3.0 kg | 3.0 kg |
| Grape pomace | --- | 3.0 kg |
| Salt | 20.0 gm | 20.0 gm |
| Sahel powder, 38% Ca | 30.0 gm | 30.0 gm |

Apparently no phosphorus, microminerals, or vitamins are added.

Diseases observed by the team included mange, occasional coughing, pityriasis, hoof cracks, and occasionaly neonatal diarrhea. Iron and copper are added by solution to the sow's udder. At birth, navels are swabbed with iodine. Scouring pigs are treated with dihydrostreptomycin.

The state farm finishes some of its pigs on other premises. Additionally, some pigs are given to the workers to feed privately. These privately fed pigs receive table scraps, brewers' grains, some soybean meal when young, and seasonally available feedstuff and scraps.

The state farm has tried AI but stopped because of the 75 percent conception rate; the conception rate for natural service is 90 to 95 percent. The Chinese blame the poor AI results on the lack of experience of the inseminators, poor sanitation, and semen-handling problems.

The farm reported 12.0 live pigs at birth and 10.8 live pigs at weaning.

Each caretaker has 20 sows to manage on a year-round basis. The caretakers follow the sows from breeding through gestation and farrowing and back again to breeding. Their basic pay is 32 yuan per month (about $23), graduated up to 40 yuan with increasing experience and longevity. A bonus program provides one yuan for every weaned pig over nine per litter and 0.70 yuan for every pound of litter weight over 280 pounds at 60-day weaning. One worker had a 600-yuan total income in 1979.

The farm vaccinates pigs with a combined vaccine for swine fever, erysipelas, and Salmonella.

Veterinary Clinic of the East-is-Red Commune

The clinic had a staff of 11 people. It has several buildings, providing 1000 $m^2$ of floor space. There are two diagnostic rooms, two animal wards, one laboratory for routine procedures, one pharmacy room, and one room for storing herbal

drugs. The veterinarians practice both western veterinary medicine and traditional Chinese veterinary medicine that has been passed from generation to generation. The Chinese are only beginning to apply scientific methods to assess the value of their traditional medicine.

The clinic serves the people's commune. The staff's highest priority is to prevent disease. They vaccinate animals and train vaccinators, sometimes called "barefoot veterinarians." The clinic veterinarians often administer medicine to neonatal animals. They castrate and spay many animals, especially pigs. They train and support the veterinarians that serve the largest production brigades within the commune. The clinic also provides hospital services to individual animals. When their animals are hospitalized, the caretakers sometimes stay overnight in the clinic sleeping room.

Most therapy involves herbal drugs and western techniques. Acupuncture is often used for therapy, seldom for anesthesia. Bulk quantities of over 50 herbal medicines were in storage.

The clinic demonstrated the procedures for pig spaying, pig castration, and stallion castration. Th pig spaying involved placing the 15-kg pig on its side and immobilizing the head with one foot and the foot of the upper rear leg with the other foot, so as to stretch the entire body. A small incision was made with a sharpened stick or semi-sharp knife in the flank area between the umbilicus and the rear leg. Because of the abdominal pressure and the correct position of the incision, the uterus was immediately exteriorixed. By gentle tugging, the entire body of the uterus and the ovaries were exteriorized,

pinched off, and discarded. The entire procedure was complete in 30 seconds. Most of the gilt pigs were spayed at weaning because "they grow better and the meat was higher quality." The pig castration was routine.

Horses were castrated without anesthesia. The horse was cast with a rope, wrestled to the ground by four attendants, and further secured by ropes. The testicles were exteriorized, the tunics cut, and the cord was broken by twisting. Sanitation was crude. We did not see the administation of tetanus toxoid.

The hospital laboratory appeared to be capable of conducting white blood cell counts, simple bacterial cultures, and direct microscopic examination of specimens. Equipment included a monocular microscope and an incubator.

By U.S. standards, the facilities, techniques, and sanitation were crude. The veterinarians, however, showed resourcefulness and considerable enthusiasm.

## Scholarly Discussions at Harbin

The veterinary science team lectured to a large group of about 100 Chinese scientists. George Lambert discussed the research work at the National Animal Disease Center (NADC), Ames, Iowa; Allen Leman discussed swine diseases, specifically atrophic rhinitis, baby pig diarrhea, pneumonia, and TGE; John Atwell discussed eradication philosophy using the hog cholera campaign as an example; David Shen discussed his work with the slow virues.

Transmissible gastroenteritis (TGE) in the People's Republic of China and methods of diagnosis. The Chinese use an FA test for diagnosis; in some areas they use virulent TGE to vaccinate. They do not have an attenuated vaccine. The disease has become more chronic and not so acute in the People's Republic of China, just as in the United States.

Atrophic rhinitis (AR). The Chinese have obviously surveyed the literature extensively. They test for AR with the tube agglutination test for Bordetella bronchiseptica. They think that the Japanese work is correct, that B. bronchiseptica "Phase I" must be present for the disease to occur; their testing of imported swine is based on this assumption. The U.S. team discussed import problems and the need to select from one or a few herds and perhaps SPF herds if they wish to lessen the chance of importing the disease. We also discussed our belief that many herds have the organism but not the disease.

Reproductive diseases of swine. Parvovirus was mentioned as a new problem for the Chinese.

Toxoplasmosis in swine. The disease was first discovered in 1977 after vaccination with swine fever vaccine; it was determined not to be due to contaminated vaccine, but the Chinese do not know the source.

Japanese B encephalomyelitis in swine. This is not a problem in some areas of the country. It produces abortions and may have been introduced with importation of Russian White swine.

Wildlife diseases. The major diseases are distemper, tularemis, and hemorrhagic septicemia.

Rabies. Rabies exists in Chinese deer that are bitten by foxes or wolves.

Acupuncture. The Chinese used this method for treatment of a wide range of diseases, including inflammation, spasmodic hernia, and rheumatism.

They have also used laser beams (helium and neon) on cattle and horses in place of other methods of anesthesia. They "light" the trunk of nerves for 30 minutes before surgery and also during surgery. This technique has been used on humans for 3 to 4 years, but on acupuncture points rather than nerve trunks.

While the veterinary team was presenting lectures, the animal science team members met with researchers, members of the animal husbandry bureau, and farm managers for a day-long discussion at Harbin. Attendees were from the Northeast Agricultural College, Harbin Bureau of Animal Husbandry, Heilongjiang Provincial Bureau of Animal Husbandry, and other locations.

The Northeast Agricultural College was moved about 600 km from Harbin during the Cultural Revolution and has been reestablished in Harbin in 1977. The staff are trying to get operational, but progress is slow. Among its activities was the work begun in 1979 as a cooperative effort between Lanxi (County Propagation Farm) and a state farm (not named, may be the Xiangfang State Farm) on the characteristics of four breeds of swine (Ming, Harbine White, Landrace, and Shanjiang). In addition to keeping performance data, the researchers are slaughtering animals at 0, 15, 30, 60, 90, and 120 kg to study histological and morphological characteristics of the digestive

tract, reproductive tract, muscle structure, and skeleton. At 90 kg, three barrows and three gilts are slaughtered from each breed group to study 20 carcass traits. Initial data indicated a distinct advantage in lean percentage for Landrace (54 percent) over Ming (47 percent); the Shanjiang (about 75 percent); and Landrace was intermediate (52 percent). The Chinese scientists indicated that the Harbin White tended to have a high percentage of both lean and fat. This trial should yield some useful and interesting data.

The nutritional research, starting in the 1960's, attempted to establish the nutritional requirements of the Harbin White and Shanjiang breeds. Standards were published in 1974, and the Central Government has taken up the work in recent years (started in 1978). Previous standards were for lard-meat type hogs; whereas the Chinese are now trying to produce meat-type hogs (the Shanjiang). Tentative feeding standards for gestation-lactation have been developed and are waiting to be approved in 1980. The Chinese are now working on feeding standards for early-weaned pigs. They have also renewed their efforts in working on fiber utilization by the native Chinese pigs.

The early development of the Harbin White was carried out at Northeast Agricultural College, of which Xiangfang State Farm was once a part. The Harbin White was developed essentially by crossing Ming x Large White and then using the Soviet White. The Shangjiang breed was developed in 1973. Ming x Landrace was the first cross; the progeny were then bred back to Landrace. Thereafter, the population was intero se mated and is therefore 75 percent Landrace breeding. Fewer breeds were available in Heilongjiang Province than in the more southern provinces.

At the request of the Chinese Ministry of Agriculture, the Chinese scientists began a detailed study of the Ming breed in 1979. The study includes characterization of the digestive and reproductive tracts, skeletal system, musculature, and endocrine system, as well as the social, eating, and nursing behavior. In most of this work, the Ming is being compared with the Landrace, Harbin White, or Shanjiang. This work is being conducted at the Lanxi farm, about 40 km from Harbin.

The college concluded a study designed to determine the ability of Ming and Landrace to digest crude fiber. The experimental pigs were about 7 months old when the test was begun. Average weight was 68 kg for the Ming and 77 kg for the Landrace. The Chinese fed both breeds a high- (9 percent) and low-fiber (3 percent) diet composed of corn, wheat bran, and soybean hay (grown especially for the hay). Digestible energy contents of the diets were high fiber, 2700 kcal per kg, and low fiber, 3300 kcal per kg. Protein content was 13 percent. Preliminary data included:

| Breed | Fiber in Diet | Digestibility coefficient, percent | | | |
|---|---|---|---|---|---|
| | | Energy | Dry matter | Crude protein | Crude fiber |
| Ming | High | 70.85 | 73.29 | 74.90 | 23.34 |
| | Low | 81.72 | 83.01 | 81.19 | 9.97 |
| Landrace | High | 69.44 | 72.66 | 72.19 | 7.94 |
| | Low | 83.47 | 85.00 | 83.29 | 21.76 |

The Chinese concluded that these data demonstrated that the Ming could digest crude fiber more efficiently than the Landrace.*

According to the Chinese scientists, the native pigs may have a lower maintenance requirement or greater capacity for fermentation in the large intestine than foreign breeds. The Ming pig "sorts" the feed and consumes only the more digestible components, whereas the non-native breeds eat everything.

The Northeast Agricultural College has also studied the reproductive traits in the Shanjiang gilt (a cross of the Ming and Landrace breeds), the Ming, and the Landrace gilts. The study in progress included five Ming, six Landrace, and six Shanjiang gilts, 8 to 9 months old, weighing 126.5 to 129.7 kg. All gilts were checked for heat with a boar three times daily (at 0800, 1300, and 1700 hours) and slaughtered 1 to 3 days after the onset of estrus. The Ming and Shanjiang gilts ovulated within 2 days, but only 50 percent of the Landrace had ovulated by 2 days after the onset of estrus. The Chinese concluded that the Ming and Shanjiang pigs ovulate sooner after the onset of estrus than the Landrace. They also indicated that the Ming gilts remained in standing estrus longer than the other breeds. They judged the maturity of the ova in the posterior one-third of the oviduct by the amount of shedding of cortical granules or lysosomes from the cytoplasm into the periventricular space. The more lysosomes

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*These results clearly demonstrate the depressing effect of high crude fiber on the other dietary nutrients (very consistent in both Ming and Landrace), an indication of the inefficient energy conversion in high-fiber diets.

shed, the more mature the ova. The objective of this research is to determine the best time to breed gilts. The Chinese indicated that conception rates are lower with Landrace gilts than with other breeds.

Ovulation rates for the Ming, Landrace, and Shanjiang gilts were 19.3, 13.8, and 15.8, respectively. The Chinese indicated that in multiparous sows from their experimental farm, the total number of pigs born and the number of pigs weaned were 12.95 and 8.61, 11.22 and 8.69, and 12.62 and 9.41 for the Ming, Landrace, and Shanjiang breeds, respectively. The ova including the zona pellucida were larger in Shanjiang (163.1 um) than in the Ming (156 um); the Landrace (160.5 um) was intermediate in size. These preliminary data are insignificant.

## URUMQI, June 4-11

The Xinjiang-Uygur Autonomous Region has a total area of 1.65 million $km^2$, with a population of 12.5 million people of 13 nationalities. Of the total land area, 50 percent is pasture, which is classified as excellent, good, fairly good, fair, or poor. The excellent and good pastures are 30 percent white clover. There are 25 million animals in the region, including 16 million sheep, 3 million goats, 2.36 million cattle, 1.20 million horses, 1.1 million pigs, 1.0 million donkeys, and 139,000 camels. There are 70,000 to 80,000 yak, which were included in the cattle figure. In addition, there are about 10 to 20 million poultry.

Their pastures are divided into spring, summer, autumn, and winter pastures. Summer pastures are mainly in the mountains, and the animals stay there from about June to September. Autumn pastures are in the foothills, and the animals stay there from September to November. The winter pastures are mainly in the valleys, and the animals stay there from November to March. The spring pastures are in the foothills, and the animals stay there from April to June. The cattle are bred in June through August. Most of the sheep are bred in November and a small percentage of them are bred in September. The spring pastures are used for calving and lambing; the summer pastures are used for fattening. The average increase in body weight of lambs and ewes over a 5-month period beginning in May is 15 kg.

The breeds of sheep are listed as following: The Xinjiang Fine-Wool sheep represents the major breed. This breed was developed from the native Kazak sheep with the Rambouliet breed. There are 1.2 million sheep that meet breed standards and an additional 6.3 million sheep that do not meet breed standards or that are crossbreds. The second breed is the Fat-Tail sheep (2 million), which has a coarse wool and represents the native Kazak breed. The Fat-Tail attains a body weight of 35 kg at weaning (4 months old). Two other breeds are the Karakul (1 million) and the Hetian, whose wool is used for making carpets.

The breeds of cattle were listed according to purpose. Dairy cattle are primarily the North China Friesian. Dual-purpose cattle (milk and meat) include the Xinjiang Brown, which was developed from the Brown Swiss, German, and Austrian Brown

cattle. Other breeds are Simmental and Shorthorn. Development of cattle for meat purposes only has just started, and Charolais from France have been imported for this purpose.

The pig breeds were listed as the Russian White, Yorkshire, Landrace, and about 20 Chinese breeds with which the Chinese are trying to develop the Xinjiang White and Xinjiang Black. The primary horse breeds are the Eli, Yangi (also called the Calisa), and Balikong. Camels are of the two-hump variety. The Chinese noted that the yak has a gestation period about the same as that of cattle, but the milk fat content is higher. Yak are used for meat and also for mountain climbing.

The poultry population fluctuates from year to year. Local Big-Boned chickens are used for meat as well as for fighting cocks. Other breeds present include the Fat Chicken, Leghorn, White Plymouth, Cornish, White Rock, and Rhode Island Red. The Leghorn was introduced around 1960 and is probably the most popular egg-laying breed. There is also a very small population of turkeys, grass geese, native ducks, and Beijing ducks. The grass geese fly away during the day to feed and return in the evening.

Xinjiang-Uygur Research Institute

The Xinjiang-Uygur Autonomous Regional Research Institute of Animal Science and Veterinary Medicine was originally a diagnostic laboratory. It was established in 1959 and split into two separate institutes in 1970. The Animal Science Institute has 54 people, of whom 32 are researchers; the Veterinary Medicine Institute has 58 people, of whom 34 are

researchers. There are about 10 research programs per year for each institute. The programs are of both nationwide and areawide interest. Most of the animal science research is done in cooperation with state farms or production units of collective farms.

The Animal Science Institute has three laboratories. The sheep research laboratory is concerned mainly with breeding. The reproduction laboratory is conducting research on frozen semen in sheep, embryo transfer in sheep, and estrus synchronization in cattle and swine. The third laboratory was for research on sheep, cattle, and swine. It was concerned with blood grouping, serum protein analysis, and chromosome analysis (karyotyping, C-banding, G-banding) of various breeds of swine and sheep. The delegation was shown some of the results on the Xinjiang White and Xinjiang Black pigs. Several Xinjiang Black and Xinjiang White strains have been independently bred at different production units, and different breeds have been introduced at different farms. These breeds do not appear to be well defined.

In fact, the Xinjiang Native Black x Russian Large White serves as the genetic base for both breeds. Apparently the black progeny became Xinjiang Black and white progeny became Xinjiang White.

Some of the equipment at both institutes included incubators, microtomes, inverted microcopes, and gel electrophoresis apparatus. The Animal Science Institute, in cooperation with the Institute of Zoology, Chinese Academy of Sciences, had conducted a study on the determination of serum

progesterone, luteinizing hormone (LH), and estradiol in sheep using radioimmunoassay procedures.

The Xinjiang-Uygur Research Institute of Veterinary Medicine has three laboratories. One laboratory was conducting research on E. coli infection in baby pigs. This disease also is a problem in lambs and calves. The Chinese use a fairly effective vaccine for older lambs. The most common types found are 0 to 139 and 0 to 140 and occasionally 0 to 141 and 0 to 148. Edema disease in older pigs and diarrhea in newborn pigs are also seen.

We visited a laboratory section doing research to develop a vaccine against spiroplasmosis in cattle. The organism is isolated from lymph tissues and grown in buffy-coat cell cultures. The researchers have made 95 passages thus far, but did not indicate that any acceptable vaccine has yet been developed. The disease is spread with the Amblyomma tick for which cattle and horses are hosts.

The parasite laboratory had a collection of 200 species of helminths from 13 species of animals. The researchers estimate that parasitic infections cause a 20 percent loss of total production. This laboratory has isolated nine new parasites. Animals are treated with chemicals.

The pathology laboratory is involved in diagnosis of infectious diseases such as swine fever, malignant catarrhal fever, equine encephalomyelitis, erysipelas, EIA, and avian leukosis. This region had an outbreak of equine encephalomyelitis in 1950 from Russia. The researchers rarely see the disease now and do not use a vaccine. Malignant catarrhal fever is associated with cattle and sheep.

The diagnostic laboratory receives difficult-to-diagnose samples from the entire region. They also diagnose local problems. Some diseases rarely identified in the area but worked on in this laboratory included: Clostridium perfringens infection; pseudotuberculosis (abscesses) in camels, first identified in 1977; and Pseudomonas in swine, which causes an encephalomyelitis. Diseases are reported to the laboratory by the Animal Husbandry Bureau, and the laboratory may be called on to conduct field investigations. Results of tests are supplied to field location by telegram or mail. This laboratory uses cell cultures for virus isolation; it does not have FA capability and conducts no tests for virus diseases of cattle.

Urumqi Municipal Veterinary Clinic

The Urumqi Municipal Veterinary Clinic has a staff of 23, including 14 veterinarians who practice both traditional and western medicine. Their major responsibilities include the control of infectious disease, especially by vaccination; cooperation with the Agriculture Research Institute, also in Urumqi; and the training of technicians for disease control.

This clinic is apparently the principal support for the one county veterinary clinic, eight clinics in people's communes, and six clinics in state farms. The clinic receives a 50,000 yuan subsidy each year for its work.

Common diseases, by species, include the following:

1. Horses: colic, respiratory diseases, and lameness. Glanders, encephalitis, and influenza have been eliminated.

2. Cattle: digestive diseases, obstetrical problems, and mastitis.

3. Sheep: parasites, against which tetramisole is useful.

4. Swine: swine fever, erysipelas, pleuropneumonia, ascariasis, mange, and lungworms.

In an effort to improve swine breeds, many pigs were imported from other parts of the People's Republic of China. With them came a variety of swine diseases. There is now more control of animal movement and better quaratine and, hence, better disease control.

The clinic had clean and newly painted rooms. There were bulk quantities of herbal medicines. One of the veterinarians has received some recent scientific training in traditional Chinese medicine. There were treatment wards and examination wards. Additionally, the staff appeared to be conducting many tube agglutination tests for swine brucellosis and agar-gel diffusion tests for Cysticercus cellulosae.

Demonstrations included acupuncture, local anesthesia in a horse, and four gilt spays. The acupuncture appeared to be only partially successful.

The clinic had a 40-ma, 90-kV X-ray machine and a nicely mechanized table especially for lung radiography in pigs, for the diagnosis of pleuropneumonia.

As seemed common for this province, there was emphasis on the many nationalities represented by the veterinarians in the clinic; however, minority hiring was not mandated or established by quota.

Veterinary education is apparently a function of agricultural colleges. Students take courses in animal science and veterinary medicine. Students or perhaps new graduates are assigned to the sheep farms from March through May to assist during lambing season. Also, teams of veterinarians move from place to place as the need arises.

Shihezi Municipality and No. 145 State Farm

The Shihezi Municipality is located in an area classified as desert. The Central Government moved army personnel into the area in 1950 for land reclamation. Because of their skills, many of the Hans Nationality were also moved into the area. The development of the area into an area of self-sufficiency reflects the success of the project.

The Shihezi Municipality now has a population of 560,000 (96.6 percent Hans) and includes 7500 $km^2$ of land. The municipality includes the city, 18 state farms, and one commune. About 15 years were required to develop a canal system to harness the water from the melting snow on the mountains and to plow the land for production. The workers have re-formed three rivers and constructed 10 water reservoirs since 1950. The city was started in 1966 and is being constructed as a model city. Development of light industry and an increase in the importance of agriculture accompanied the development of the city. There are now 1400 tractors of different sizes and 300 combines in the municipality. The workers have constructed 14,000 km of irrigation channels and planted 8700 ha of trees (for environmental improvement) plus 2000 ha of fruit trees.

The Chinese were particularly proud of their industrial development based on their raw materials and their self-sufficiency (in everything except iron, steel, and farm machinery). They have 10 to 12 small factories, including those for wool and cotton textiles, spindles, paper, diesel engines, electric generators, coal, and food. They reported that over 100 processing shops were found on state farms and the commune. About 76 percent of the total income comes from industry.

Agriculture, in contrast to industry, was not as advanced and represented only 13 percent of the total income. The inventories of 1980 include about 120,000 hogs, 310,000 sheep, 15,000 cattle, 12,000 horses, and 200,000 chickens. The main breeds are Xinjiang Large White pigs, Fine-Wool sheep, black-and-white (Friesian) cattle, and White Leghorn chickens. Meat (6000 tons per year) and wool (1200 tons of Fine Wool and 6000 Karakul lamb skins per year) are the primary products. Milk and eggs are produced mostly for home consumption.

The No. 145 State Farm has a herd of 79 sows, 70 bred gilts, and 14 boars. The staff's primary mission is to propagate the Xinjiang Large White to provide breeding animals for the other 17 state farms and the commune. The group visited the boar battery and the developing gilt, gestating, and farrowing facilities. Compared with other swine production units, facilities, sanitation, and overall management were less than adequate; however, the first evidence of mechanization of manure management (a rotating manure-alley cleaner) was found in a facility for developing gilts.

The Chinese reported an average of 10.5 pigs farrowed per litter, with a weaning average of 7.0 to 8.5 pigs per litter. They farrow only twice per year (consistently found in all operations). A 95 percent conception rate (number farrowing per number bred) was reported when three matings were used. The farm staff tried one artificial insemination trial, but the results were poor (they indicated poor technique). They expressed interest in using AI to save on the amount of feed that is fed to boars.

The feeding regime again reflected an attempt to develop a program to utilize the feeds available in the area. During gestation, females were self-fed a mixture of concentrate (70 percent corn, 15 percent wheat bran, 15 percent cottonseed cake), ground alfalfa hay, and fermented sugarbeet pulp. The mixture, about 5 kg per day, usually contained about two-thirds of the concentrate mixture and one-third of the roughage feedstuffs. The same feeding regime is followed during lactation, except that more of the feed is provided. Pigs are fed the same diet from weaning until they weigh about 90 kg. It includes about 55 percent ground corn, 10 percent cooked whole soybeans, 5 percent cottonseed cake, 15 percent roughage (ground alfalfa hay and fermented sugarbeet pulp), 15 percent wheat bran, 0.5 percent salt, and a commercial growth stimulator. The additive (a complex trace-mineral premix) was manufactured by the Wangxin People's Commune, Jadin City, Shanghai Municipality. It was recommended for swine and poultry. It contained, per 100 gm: cobalt chloride, 0.1 gm; manganese sulfate, 0.15 gm; iron

sulfate, 0.15 gm; potassium iodide, 0.05 gm; copper sulfate, 0.15 gm; zinc sulfate, 0.20 gm; magnesium sulfate, 0.15 gm; boric oxide, 0.05 gm; and furacin, 0.005 gm. Fed at the recommended rate of 0.2 gm of premix per kg body weight, a 50-kg pig would be fed 10 gm premix daily, which would provide (if the pig consumed 5 percent of its body weight daily -- 2500 gm) in the complete feed less than 4 ppm of all trace elements. The levels were much lower than levels provided in U.S. diets. The product costs 0.7 yuan per 500 gm; therefore, it would cost nearly 0.03 yuan per day per 50-kg pig.

The Chinese vaccinate twice yearly for hog cholera, erysipelas, pasteurellosis, and Salmonella paratyphi in one injection. They vaccinate (intramuscularly or by aerosol) once yearly with M-5 brucellosis. If the aerosol method is used, they use 100 million organisms per animal. The volume of a room is measured, and a dose of 100 million organisms per $m^3$ is sprayed into the area. If the treatment is given in an open area, more organisms are used. On farms where there are no cattle, they may use S-2, but it must be given three times per year. The S-2 vaccine is given in the water or sprayed on the feed at the rate of 100 million organisms per animal.

## August 1 Agriculture College

The August 1 Agriculture College in Urumqi was reestablished in 1979. It now has 71 laboratories with 1500 students, 470 teachers, and 13 subjects (majors).

The Department of Animal Science and Veterinary Medicine has three subject areas: animal science, veterinary medicine, and grasslands. The department has 10 classes (six are for Hans and four are for the minor nationalities) and 17 teaching groups. It has a total teaching staff of 140 and more than 400 students. The department has a veterinary medicine hospital, an animal farm, a mink breeding farm, and a grassland experimental farm. The students have a 4-year course of study in either animal science or veterinary medicine. The basic subjects (such as chemistry, physics, and mathematics) and the basic major subjects (such as biology, anatomy, physiology, and microbiology) are about the same for both courses of study. The major subjects for veterinary medical students include internal medicine, surgery, infectious diseases, parasites, and traditional medicine; the major subjects for the animal science students include cattle, swine, sheep, horse, and poultry science.

The delegation visited some of the laboratories. The staff stated that many of their research programs are performed in cooperation with production units in the region. The pathology laboratory was studying hog cholera, Salmonella , and Pasteurella in swine; tuberculosis and paratuberculosis in cattle; and glanders in horses. The microbiology laboratory was concerned with bacteriology, 60 percent; virology, 20 percent; and immunology, 20 percent. The parasite laboratory had a collection of many species of parasites. The specimen laboratory had a collection of numerous preserved animals, fish, birds, reptiles, and parasites. Their histoembryology laboratory was conducting

studies on spermatozoa, chromosomal manipulation by exposure to mutagens, and tissue culture with guinea pig tissue. Their frozen semen laboratory was established in 1975 and is the center for processing semen for the area. There are three breeding farms for bulls in the area. A new center for freezing semen in being built about 6 km from the college, and it will also house all of the bulls used to supply semen for freezing. In 1979, 25,000 cows were inseminated with frozen semen; 75 percent of these cows were dual purpose. The conception rate was over 90 percent in dairy cattle and 60 to 80 percent in beef cattle. Most of the semen is frozen in pellets, but the staff stated that more straws will be used in the future. We were also told that research was being conducted on breeding of the Ili White pig (a strain of the Xinjiang White), fungus in sheep and cattle, and early detection of pregnancy in cattle with ultrasonics, but the details were not discussed.

Veterinary Bioproducts Factory at Urumqi

This factory was established in 1958 and began producing in 1960. It has a total area of 498,000 $m^2$, including 23,000 $m^2$ of housing, of which 16,000 are for manufacturing bioproducts. The plant employs 307 workers representing nine nationalities; 47 workers are minorities. There are 45 administrative personnel, 34 technicians, and 228 manufacturing workers. The plant's cash flow annually is 740,000 yuan, exclusive of salaries, which account for 160,000 to 180,000 yuan. Each worker produces 5000 yuan of value per year.

The plant is composed of five workshops and an experimental laboratory farm. The workshops are as follows: Bacterins and sera; vaccines; media, disinfectants, and chemicals; veterinary anthelmintics and trypsin; and energy supply and maintenance.

Quality control is very important and is under the control of Beijing. At Urumqi, the Quality Control Staff includes 6 technicians and 13 workers.

Bioproducts are produced according to the needs of the region. Two types of vaccines, freeze-dried and liquid, are produced. More than 60 million ml of liquid vaccines and 20 million ml of freeze-dried vaccines are produced. Major emphasis is on vaccines for sheep and cattle, with only a few products for poultry and swine. The staff was concerned about some of its primitive techniques and lack of mechanization.

Vaccines produced included Strain 2 Newcastle disease vaccine for baby chicks. The vaccine was attenuated, and vaccination was repeated when the chicks were 2 months old.

A swine fever vaccine (K strain) was also produced in accordance with Beijing regulations. The anthrax vaccine was grown in agar culture; and when the spore-forming organisms were over 90 percent, they were harvested in 30 percent blood serum-distilled water in 30 percent alcohol. The number of spores in 1 ml of solution was calculated; then the preparation was diluted so that the final product contained 15,000 to 25,000 cells per ml. The seedstock was checked for virulence, purity, and spore concentration regularly and was avirulent for humans.

A brucellosis vaccine M-5 (melitensis) was produced for use on sheep, goats, and cattle. It is tested for safety and purity but not for potency. The potency test had been done many times in Beijing before the product was released to the province and autonomous regions biofactories. Th biofactory also produces an E. coli bacterin for prevention of lamb dysentery. Clostridium perfringens types A, B, C, and D bacterins and toxoids are produced to overcome losses from enterotoxemia. Other products include vaccines for contagious bovine pleuropneumonia and sheep pox. All viral products are desiccated.

A combined bacterin for blackleg, "struck," and enterotoxemia is also produced. The biofactory has a central laboratory supply unit that provides media for bacterins, chemical solutions, disinfectants, and cell culture fluids for virus propagation.

Urumqi Breeding Farm

The delegation visited the Urumqi Breeding Farm of the Xinjiang-Uygur Autonomous Region. This breeding farm is involved mainly in cattle and sheep production, but it has a small area of crops. The farm encompasses about 3000 ha; 2000 ha are pasture land. Of the 5000 people on the arm, 1300 are staff or farm workers.

The farm had a cattle inventory of about 1200 head, including 600 Xinjiang Brown, 300 Friesian, and 300 native cattle. The Xinjiang Brown was developed by use of Brown Swiss to upgrade the native cattle. On the average, the herd is 7/8 Brown Swiss, but some individuals are 15/16 or 31/32 Brown Swiss.

The original Brown Swiss were imported from Russia and were chosen because the breed is dual purpose. The herd has been bred by AI since 1964. Two years ago, the workers started using frozen semen supplied by the August 1 Agriculture College. Conception rate to first service is 50 percent; a 75 percent conception rate was reported for the year. The calving interval is 460 days. The cattle are grazed on natural pastures in the summer. They are confined and fed alfalfa hay and corn silage in the winter. They receive little or no concentrate and no vitamin or mineral supplement. Under these conditions, the average annual milk production is 3000 kg, with twice-a-day milking. Cattle are vaccinated for anthrax and checked for brucellosis and tuberculosis. Pleuropneumonia used to be a problem but has now been eliminated. Stillbirths are 1 to 2 percent, and calf mortality is 1.5 percent.

The Fat-Tail sheep number about 6000 and are kept mainly for mutton. The wool is used to produce felt, which is used in tents, blankets, and other such goods by the farm people. This breed is rugged and adapted to natural pastures. Mature rams weight 100 kg and mature ewes 80 kg. The average annual wool production is 1.5 kg. Breeding is in the fall, and the lambs are born in April and weaned in August at an average weight of 40 kg. The workers report conception rates of 90 to 97 percent, and 110 lambs are born per 100 ewes lambing. All breeding is by natural service, and rams are purchsed from the Altai region. Excess lambs are sold to the Urumqi Food Company for slaughter. Carcasses are sold to Shanghai and Beijing or put in cold storage.

The Xinjiang Fine-Wool breed was initiated before 1949. The breed is based primarily on Rambouillet, but some Australian Merino have also been introduced to increase fiber length, staple length, uniformity of wool, and percentage of clean wool. The average annual wool production is 4.5 kg, and average fiber length is a little over 5 cm. The percentage of clean wool is 50.2. All Fine-Wool sheep are bred by AI with fresh semen. The conception rate is 90 or higher percent. The workers report that 151 lambs are born per 100 ewes lambing. The sheep are given no supplemental minerals or vitamins. Scabies is no problem, because the workers dip the sheep twice a year. They reported some problem with internal parasites but no foot rot or abscesses. Predator losses, due mostly to wolves, are 1 to 2 percent. The bounty on a wolf is one lamb. Sheep not leaving the farm are vaccinated with M-5 brucellosis vaccine; those leaving the farm are quarantined and checked for brucellosis. There is some mastitis, and ewes with mastitis are culled. The Fine-Wool sheep are primarily for wool.

The farm also has 500 horses, used for stock handling and draft.

## Scholarly Discussions at Urumqi

In the swine breeding area, scientists from the August 1 Agriculture College and the Xinjiang Research Institute of Animal Science explained that their main efforts were directed toward improving the Xinjiang White and Xinjiang Black breeds. Two methods were being used: population breeding and selection of best individuals on performance. The scientists also use

blood typing and chromosome analyses to more adequately define the germplasm in the Xinjiang White and Xinjiang Black, used as female lines. The Landrace and Meijiang are used as male lines.

The only research on nutrition and feeding in the autonomous region was a finishing trial being conducted by a feed company, under the leadership of the Ministry of Agriculture (some feed companies are under the Ministry of Cereals). Pigs were weaned at 65 days (10.2 kg), prefed for 75 days, and started on test at 20.2 kg. The scientists divided the finishing period into three time periods (30, 61, and 31 days) and fed three diets. Average daily gain during the finishing period was 560 gm, wth 3.42 kg corn fed per kg of gain. Pigs averaged 88.5 kg live weight at 62 days of age. No one could explain why a higher percentage of corn and linseed meal and a lower percentage of wheat bran were fed during the last part of the finishing period than at the start of the feed program period.

The staff of the research institute indicated that their basic swine-feeding program included the following diets:

| Ingredients | Concentration of ingredients, percent | | |
|---|---|---|---|
| | Starter | Grower | Finisher |
| Crude protein | 14 | 12 | 10 |
| Corn | 50 | 60 to 70 | 70 to 75 |
| Sorghum | 5 | -- | -- |
| Soybean meal | 2 | -- | -- |
| Linseed meal | -- | 10 | 8 |
| Wheat bran | 20 | 20 | 15 |
| Alfalfa hay | 5 | Varies | 5 |
| Soybean pulp | Varies | Varies | Varies |

The scientist from Shihezi City indicated whole soybeans were used in the feeding program. The workers boil the beans for baby pigs and panfry them for the finishing pigs and breeding herd. They also use 5 to 10 percent cottonseed meal in diets.

When a market hog (90 to 100 kg) is sold to the Central Government, the producer is eligible to purchase 1 kg of corn or 2 kg of wheat bran. Other concentrates are not available for swine feeding in the region. A producer has an allotment of 0.02 ha of green fodder land in the commune for each hog raised. He can grow whatever crop he wants on the land for his hogs (mostly corn is grown). Soybean meal is not available except through the communes, which might get the meal back from the soybeans they sold to the Central Government for processing.

## SHANGHAI, JUNE 11-15

### Brick Bridge Commune

The group visited the Brick Bridge Commune located about 30 km northwest of Shanghai. The commune was established in 1958 and has a total staff of 120. The staff is divided into five working groups: making noodles from cereals, operating a hatchery, producing green fodder crops, acting as quartermaster, and feeding swine.

The swine feeding group includes 20 workers, 11 animal houses, 98 breeding sows (20 sows in nucleus herd), and 5 boars (4 Funjing, a strain of Tai Lake, and 1 Soviet Large White). It also has about 132 spring-farrowed gilts, of which about 20

percent will be retained as replacement gilts. It also has 36 developing Funjing replacement boars and 160 finishing pigs (Funjing and Soviet Large White crosses).

The primary objective of the farm is to select and develop good Funjing breeding animals for use in swine production in the production brigades in the Brick Bridge Commune. The Chinese listed the main features of the Funjing strain as large litter size (15 or more farrowed), good mothering ability, adaptability to production conditions in the Shanghai area, and desirability of the meat (flavor and tenderness). However, they listed the main disadvantage of the Funjing as its low average daily gain (about 400 gm) from weaning to finishing.

The breeding program for development of the Funjing started in 1970 when the breeders exercised selection pressure on about 70 animals and retained 11 sows and 2 boars. Selection pressure was primarily in litter size and growth rate. The breeders finally selected two females (No. 116 and 130) and one male (No. 0) as the base for the Funjing breed. Through linebreeding (the exact procedure was a bit unclear), they developed 110 animals that have been carefully selected for body length, litter size, and daily gain to develop the current Funjing strain. They estimated that the current level of inbreeding is 6.4 percent in the whole population and about 12 percent in the 20-sow elite herd. They indicated that they had turned as many as four or five generations, but the average is much less, because they keep a sow through 10 litters (desired body weight at culling is 160 to 175 kg).

Production figures for three stages (1970-76, 1977-79, first half of 1980) are as follows:

| Item | 1970-76 | 1977-79 | First 6 months of 1980 |
|---|---|---|---|
| Litter/year/no. sows | 182/113 | 248/130 | 98/98 |
| Average total no. pigs born | 14.7 | 15.1 | 15.2 |
| Average no. pigs born alive | 12.9 | 13.4 | 13.3 |
| Average no. pigs weaned | 10.7 | 12.4 | 12.4 (96 litters) |
| Average birth wt./pigs, kg | 0.73 | 0.81 | -- |
| 60-day wean wt./pigs, kg | 14.8 | 17.0 | 17.7 |
| 60-day wean wt./litter, kg | 161.5 | 212.7 | 218.8 |

The breeders were quick to point out that the improved production realized in 1977-79 over that in 1970-76 resulted largely from improved nutrition and management. They indicated that the addition of an incentive program for workers and the much closer supervision of attendants had greatly improved production efficiency. Farrowing is mainly in March and September, with one person responsible for 16 sows. That person is responsible for everything on his/her sows except the actual breeding. One person in in charge of the semen collection and AI.

The breeders have used AI extensively since 1970 (extended fresh semen) and about 97 percent of the matings now are by AI. They reported an 85 percent conception rate on two inseminations per estrus. The extender used included 5 percent glucose, 0.3 percent sodium citrate, 0.1 percent disodium ethylenediamine-tetraacetate (EDTA), and 0.1 percent sulfa (SN) powder. They do

not use a boar to detect estrus but frequently check the sows for increased activity and swollen vulvas. They inseminate artificially with 4 billion sperm per insemination (40 ml total volume) at 36 hours after onset of estrus and then 6 to 8 hours later. They attributed much of their technology to the close working relationship that they maintained with scientists in the Shanghai Municipality and County.

The feeding program appeared to be fairly stable throughout the year and showed more advanced technology than that at any other farm visited. It included a gestation mixture of 60 percent cereal grain (corn, barley, wheat), 35 percent wheat bran, 5 percent cottonseed meal, 1 to 2 percent minerals, and 0.5 percent salt. During lactation, 5 percent of the wheat bran was replaced by 5 percent fish meal. The workers fed the lactation concentrate to weaned pigs for 2 months and then changed to the gestation concentrate. The concentrate was mixed with green fodder (four water plants as well as vegetables were extensively used) and water in a specific ratio (weight) for each class of swine. The green fodder: concentrate:water ratios for the various classes were: gestation, 8:1:2; lactation, 2-3:1:2; finishing, 5:1:2. These were mixed in large concrete bowls at the end of each house and fed in concrete troughs in the pen. The workers add no vitamin or trace mineral premixes; the green aquatic plants and fish meal should provide everything needed except possibly $B_{12}$ during finishing.

The Chinese indicated that mycoplasmosis and baby pig diarrhea were their major disease problems. Using a combination vaccine, they immunize replacement gilts at about 5 to 6 months

of age for hog cholera, erysipelas, and salmonellosis. They also vaccinate all animals in April each year for Japanese B encephalitis, which is transmitted by mosquitoes. Infection results in stillbirths and mummies. Feeding the aquatic plants year round also subjected all animals to flukes. The fluke the Chinese reported, Fasciola buski, is red, about the size of a lima bean, and lives inside the lumen of the intestine. All breeding animals are wormed twice a year with tetramisol to control roundworms. Finishing pigs were treated once or twice as needed. Dichloral sulfate was used for flukes.

Good management practices were observed during the tour of the farm. Houses were open to the south, with about one-half of the concrete floor covered with a thatched roof. There was good separation among various age groups, and all animals were in small groups with more than adequate space (one or two gestating sows per pen, six developing gilts or boars per pen, and ten finishing pigs per pen). Sanitation appeared excellent, and buildings were freshly whitewashed and ultraclean. Herd health appeared good; no sneezing or coughing was observed.

Apparently, the Chinese have developed a line with excellent reproductive capacity. Gilts normally cycle at 4 months of age and breed at 8 months; litter size appears good. The workers reported that the Funjing females are used by the production units in the communes to cross with Russian Large White boars to produce crossbreds for finishing. Their crossbreds looked good and had averaged 550 gm per day going from weaning to market, but their Russian Large White boar was a good individual (excellent capacity, depth, and length). They

seemed to be concerned about the extent of inbreeding in their herd. Two ways to decrease their inbreeding coefficient were pointed out: keep a long generation interval (but this reduces genetic progress) or go outside for boars. They stressed that if they use the second approach, they should test the boar before using him extensively to be sure he does not reduce the reproduction efficiency of the herd.

Shanghai 7th Dairy Farm

This state farm began production on their current 25-ha site in 1958. The staff of 413 people, including 143 women, is divided into three working teams. Two teams are responsible for the 1080 milking cows, and one team is responsible for the 720 heifers. Production was 4148 kg of milk per cow per year in 1958 and 6351 kg in 1980.

Replacement heifers are vaccinated when they are 6 months old with strain 19 Brucella abortus vaccine; the milking herd is tested yearly for serologic evidence of brucellosis. The herd is tested for tuberculosis twice yearly. Major calfhood problems are enteric and respiratory disease, but mortality is low because weak and sick calves are quickly slaughtered for veal. Slaughter at 2 to 3 days of age is the usual fate for bull calves except for potential sires from superior females and a few bull calves for experimental feeding trials. The major disease on the farm is mastitis, mostly from "Streptococcus organisms and faulty milking or equipment." Ketosis and milk fever are not common. There are more cases of retained placentas in July and August; these are removed and the uterus

is treated with antibiotics. The four veterinarians on the farm are assigned one to each production team and one as chief veterinarian. Diagnostic service and assistance are available through the milk company.

Replacement heifers are selected from a nucleus of 500 cows. They are sired by 1 of 24 bulls at the Shanghai AI Center. After a series of culling procedures, about 20 percent of the heifers are retained for replacements. The farm has two female heifers, producing about 9800 kg of milk. One has been selected as a sire mother.

Cows are moved into individual free stalls for calving; they are observed 24 hours per day. The calf is moved to an individual bedded crate for 3 days and fed mixed colostrum. After 3 days, the calf is moved into a large stall with fresh bedding for 15 days. Air movement is excellent and calf density very low. Bedding is replaced daily; floors are cleaned and disinfected. The diet during this time is cow's milk. After 15 days, the calves are moved to another barn, where roughage feeding is begun. Again the barn was airy and very clean. Age separation was excellent. Our only concern was that the environment was too wet, perhaps as a result of cleanup for our visit or the high ambient relative humidity.

After freshening, the cows were moved to a separate stanchion building for close observation, hand milking, and limit feeding for 15 days. If a cow is healthy after 15 days, she is transferred to the milking barns.

Cows are milked three times daily by machine in a stanchion barn. Udders are massaged and teats are washed. Some of the milkings are timed. The machine bucket is weighed and milk production recorded. Milk is strained through cheesecloth into traditional milk cans. Milk is removed for pasteurization and processing on the same farm. There was no evidence of teat dipping or between-cow disinfection of the machine. Cows were all stripped after machine milking. The milking barns were abustle with people feeding the cows and cleaning the barns.

Heifers reach about 300 kg at 1 year of age. Mature cows weight 600 kg. Mature milking cows are fed 1.5 kg of concentrate per cow per day plus 0.22 kg of concentrate per kg of milk produced. Additionally, milking cows get 17.5 to 20.0 kg of corn silage, 3.0 kg of hay, and limited amounts of available green fodder, including cabbage, water plants, and turnips. The concentrate is corn, barley, sorghum, and cottonseed meal. Because of the water-plant feeding, liver flukes are a problem.

Heifers and cows are given three daily exercise periods in adjacent dry lots. Most estrus is detected during these periods. Frozen semen, either in pellets or straws, is used on all heifers and cows. The conception rate was said to be 90 percent per year, and the actual calving rate was said to be 85 percent. The calving interval was 13 months. There was no evidence of a postpartum or early pregnancy palpation program.

Fly control is facilitated by manual removal of all fecal matter as soon as it is deposited.

Seasonally available green fodder being fed during the milking period that we observed was cabbage heads and water weeds. Whether these fresh green plants affect the flavor of the milk was not determined.

We observed excellent sanitation, excellent facilities and building design, and maintenance. Ceilings were high, and the natural ventilation assured ample air movement. We observed dairy cows that seemed smaller and more beefy than the U.S. breeds. Although management seemed to be excellent, the lack of concentrated feed and the low genetic potential of their cows seemed to be the greatest limitations on increasing production.

Xinjing Poultry Farm

The Xinjing Poultry Farm is located on a commune on the outskirts of Shanghai. The commune was established on October 1, 1958, and consists of an area of 17.7 $km^2$. There are 11 production brigades and 5990 households, with a population of 21,400. About 14,100 of these are laborers. The total arable land is 930 ha, of which 601 ha are devoted to vegetable production, 184 ha to cereals, and 67 ha to fodder crops for the Shanghai Milk Company. Seventy-eight hectares are devoted to private use of the commune members.

The main function of the commune is to produce vegetables and animal protein for the city of Shanghai. In 1979, for Shanghai, the commune produced 60,000 tons of vegetables, 33,000 head of finishing hogs, 493,000 chickens, 2.65 million kg of eggs (mostly duck eggs), and 90,000 kg of mushrooms.

Educational facilities at the commune included 12 elementary schools, 2 middle schools, and 1 high school. The commune has one major hospital and several clinics. Per-laborer annual income in the commune for 1958-59 was 268 yuan; however, by 1979, it had increased to 647 yuan. The per capita annual income in 1980 was 427 yuan. Members own their own houses, with an average of 15 $m^2$ per person. Since 1978, the workers have had a good retirement plan in 10 brigades. At 65 years of age, they can retire on an income of 18 yuan per month.

At this commune, the team visited three of the production areas: the laying houses of the chicken production team, the duck farm for production of duck eggs, and a larger poultry-production unit equipped with semi-mechanized facilities.

Some management training was provided for the leaders, but the "Revolutionary Committee provided the overall leadership for crops, site, and industry." About 75 percent of the commune members were not party members.

The chicken laying houses contained 4000 hens in laying cages (three hens per cage). The premises were sprayed regularly for fly control.

Chicken feed was formulated as follows:

| | |
|---|---|
| 40 percent corn | 8 percent rice byproducts |
| 15 percent barley | 4 percent soybean meal |
| 8 percent wheat bran | 12 percent fish meal |
| 4 percent rice bran | 3 percent pupa of silkworm |
| 4 percent mineral | 2 percent shale |

Vitamins and trace minerals

The management system provides for an all-in, all-out program to prevent carryover of disease.

The duck facility houses 3000 ducks. The ducks were turned out to swim all day in a man-made pool and returned to the house at night. Purchased as ducklings from Xingjiang County, they produced an average of 280 eggs (17 to 18 kg) per year, usually laying their eggs at night.

Shanghai Research Institute

The research objective of the Research Institute of Animal Science and Veterinary Medicine of the Shanghai Academy of Sciences is to solve problems of animal production and disease in the region of Shanghai. Of the staff of 300, 40 are researchers in animal science, 50 are researchers in veterinary medicine, 20 are administrators, and the others are laboratory or field workers. The research is distributed among six laboratories and an experimental animal farm.

Laboratory 1 has four programs:

1. Selection and breeding of Tai Lake swine (nine strains).

2. Selection and breeding of Shanghai White and assuring its suitability for combination with other breeds.

3. Selection and breeding of Podong chicken.

4. General survey of germplasm of Shanghai area animals. Researchers want to identify the type of germplasm most effective for future breeding work.

Laboratory 2 also has four programs:

1. Research on complete feeds for swine. Researchers want to work out the best formula of feedstuffs available in the Shanghai area for large, integrated operations.

2. Research on poultry feeds.

3. Long-term study of the feasibility and safety of feeding petroleum single-cell protein in swine and poultry diets. After 10 yers, the work is now nearing completion. Single-cell protein has been found to be perfectly safe.

4. Study of utilization of animal wastes. Fermentation by microorganisms is used to treat swine wastes for poultry feeding and poultry wastes for swine feeding.

The Animal Husbandry Experimental Farm has the capacity for 2500 experimental pigs and 140 sows. Present research is directed toward breeding the Shanghai White swine, determining the most efficient diet formulation for swine feeding with native feedstuffs, and combining various breeds for commercial production.

The nutrition laboratory (Laboratory 3) is equipped for various analyses. The environmental unit is equipped with a modern gas chromatograph (Shinadzu - made in Japan) for checking the levels of benzene hexachloride (BHC) and DDT in meat products. The amino acid analysis room is equipped with a modern amino acid analyzer (Lacorte - made in England) for measuring the amino acid composition of commonly used swine feedstuffs and research diets. A fluorescence spectrophotometer is used for

vitamin analyses; at present, only $B_1$ and $B_2$ are analyzed. A late-model adiabatic bomb calorimeter was used for gross energy analyses of research samples for this institute and other organizations. The laboratory is well equipped to perform proximate anlaysis of protein, fat, crude fiber, and ash. The Chinese indicated that they were performing these analyses for their research diets, for communes that are evaluating complete diets, and for others that are attempting to feed with modern technology.

No research on reproduction is being done at any institution or university in the Shanghai area. Work is being done in Jinshan County (started in 1979) and Jiading County (started in 1980) to describe the reproductive characteristics in the Tai Lake strains. No information is available yet. The Shanghai Milk Company has just established a dairy-cattle research institute to work on artificial insemination, frozen semen, and embryo transfer.

Research laboratory 4 is devoted to research on poultry tumor diseases and histopathological diagnosis of selected diseases in the Shanghai area and in the state and commune farm flocks. This laboratory is also involved in biochemical and biophysical analyses and toxicology. Three research programs are in progress:

1. Swine mycoplasmosis research is particularly related to the pathogenicity, treatment, and immunity, and isolation and characterization of the organism. Attenuation attempts have been unsuccessful.

2. Transmissible gastroenteritis research concerns etiology, prophylaxis, and treatment. Researchers have compared American and Japanese isolates with the Chinese isolate. The Chinese isolate differs serologically. Researchers vaccinate orally and intramammarily.

3. Marek's disease research is related to diagnosis, treatment, and etiology. Additional research concerns isolation and surveys for avian bronchitis and infectious bursal disease. Researchers are also studying optimal vaccination programs for large, integrated poultry farms.

Laboratory 5 is used for research on toxoplasmosis of swine, swine dysentery, colibacillosis in baby pigs, and coccidiosis of chickens.

Laboratory 6 is used for environmental protection studies and standardizing poultry feed for contents of BHC and DDT to control residues in meat.

## GUANGZHOU, JUNE 16

### South China Agricultural College

The South China Agricultural College is located on the outskirts of the city of Guangzhou (Canton) in the Pearl River Delta, in typical tropical and subtropical surroundings. The college is an old college with a long history. It is one of the

key institutions of higher education in the People's Republic of China, shouldering the responsibility of training senior agricultural specialists and engaging in major agricultural scientific projects assigned by the state. South China Agricultural College was established on November 10, 1952. It resulted from a conglomeration and reorganization of the agricultural colleges of Zhongshan University (Sun Yat-Sen University) and Lingnam University (these two agricultural colleges were founded in 1917 and 1916, respectively), and part of the Animal Husbandry and Veterinary Medicine Department of Guangxi University.

There are eight departments and 15 specialties in this college, as follows:

1. Agronomy Department

   Agronomy
   Genetics and Plant Breeding
   Agricultural Economics
   Tea Growing (and Processing)

2. Soil and Chemistry Department

   Soil Science and Agricultural Chemistry

3. Plant Protection Department

   Plant Protection

4. Forestry Department

   Silviculture
   Forest Protection

5. Animal Husbandry and Veterinary Medicine

   Animal Husbandry
   Veterinary Medicine

6. Horticulture Department

   Pomology
   Vegetable Culture

7. Farm Mechanization Department

Farm Mechanization
Farm Machines and Tool Designing and Manufacturing

8. Sericulture Department

Sericulture (raising silkworms)

Some academic specialties will be reestablished, and a new department of biological sciences is being organized. The college plans to set up a certain number of new specialties in furtherance of agricultural modernization and agricultural science.

A central laboratory was founded in April 1979, for the introduction of large, modern, sophisticated instruments in the college. Use of such equipment is expected to promote scientific research and enhance teaching levels. The central laboratory, with a 400-$m^2$ floor space, is now under construction. A transmission electron microscope of 80,000X magnification and 1.5 A resolution and a scanning electron microscope have recently been put to use. An electronic computer had been ordered and installed in 1980. Other precision instruments for qualitative and quantitative analyses, tissue culture, and remote sensing will be procured. The Laboratory of Biophysics, which was established in 1959, is now under the administration of this central laboratory.

An experimental farm was established in 1924 by the former Agricultural College of Zhongshan University. Since Liberation, the farmland has been fundamentally ameliorated, and mechanization and scientific farming have been promoted. The farm now covers 5000 mu (333.3 ha), including land used for farming;

forestry; stock raising; tree nurseries; and fruit, vegetable, mulberry; and tea growing. It serves as an important base for teaching and scientific research.

The college has a total collection of about 500,000 books, including 70,000 bound volumes, and 120 periodicals in English, Russian, German, and French. Ancient Chinese agricultural literature is one of the major collections in the library. It amounts to 30,000 books, many of which, such as original editions, manusripts, and sole copies, are rare in the People's Republic of China. A Chinese Agricultural Heritage Research Laboratory, established in 1979, engages in systematic researches in ancient Chinese agricultural literature.

Training for agricultural specialists in this college includes undergraduate courses, graduate courses, and short courses for the leading agricultural cadres, teachers, and technicians.

All the undergraduates admitted are high school graduates selected from among the best ones passing the state entrance examination. Four years are usually required for graduation; but for students majoring in designing and manufacturing of farm machines and tools, or in the veterinary medicine, 5 years are required.

Upon graduation, the students are assigned jobs in agricultural schools, research institutions, the various levels of administration in the district, or provinicial government. During their school years, all expenses for study, boarding, and medical care are shouldered by the state. Most of the students

get state sipends (student subsidies) for their boarding fees and daily expenses. Some of the students from well-to-do families do not receive state subsidies.

Graduate students are admitted from all parts of the country through entrance examinations. Three years are required to complete their programs, and the students are required to submit a research thesis and pass the examinations on major subjects. Jobs in colleges and research institutes are assigned to them by the state upon graduation.

The college has resumed admission of graduate students since 1978. The number of graduate students in the years 1978 and 1979 was more than the total from 1953 to 1966. Many more will be admitted in the years to come.

Short-term training classes have been conducted for the leading cadres in charge of agricultural production at the provincial, district (region), and county levels. They are enrolled from the three provinces (Fujian, Guangxi, and Guangdong). Basic courses in agriculture are given to enable them to direct production in keeping with the basic principles of agricultural sciences and agricultural economics.

Listed below are courses offered to undergraduate students majoring in agronomy and veterinary medicine, respectively. These will serve as examples of the curricula in the other departments and specialities.

Specialty of Agronomy. Required courses include: history of the Chinese Communist Party, political economy, philosophy, natural dialectics, physical culture, and foreign language (English or Japanese); higher mathematics, physics, general and

analytical chemistry, organic chemistry, botany, plant physiology, and plant biochemistry; general genetics, microbiology, meterology, soil science, and field experimentation and statistics; fertilizers, fundamentals of entomology, insect pests of farm crops and their control, plant pathology, farm mechanization, agricultural economics, food crops, and crop breeding.

Electives include: plant taxonomy, biophysics, seed science, cytology, scientific English, theory of evolution, surveying, and ecology of crops.

Specialty of Veterinary Medicine. Required courses include: history of the Chinese Communisty Party, political economy, philosophy, natural dialectics, physical culture, and foreign language (English); higher mathematics, physics, general and analytical chemistry, organic chemistry, animal biochemistry, anatomy of domestic animals, histology and embryology of domestic animals, animal physiology, animal pathology, veterinary microbiology, veterinary pharmacology, clinical diagnosis, X-ray diagnosis, animal husbandry, and animal hygiene; Chinese veterinary medicine, veterinary medicine, veterinary surgery, veterinary obstetrics, infectious diseases of domestic animals, veterinary parasitology, and poultry diseases.

Electives include: animal immunology, swine husbandry, ranch management, cattle husbandry, poultry husbandry, and scientific English.

Since 1952, more than 100 individual items of the scientific research projects have yielded important results, most of which have been put into practice. Four projects and six items won awards at the 1978 National Science Conference. They are:

1. Characteristics of response of the Chinese rice varieties to photoperiod and temperature

2. Rice tillering and panicle differentiation

3. The application of insect juvenile hormones to increase silk production in silkworms

4. The treatment of swine mycoplasma pneumonia

5. Simplified method of production and application technique for the new agricultural antibiotic "Jing-gangmycin"

6. Integrated insect pest management

The U.S. team saw an excellent acupuncture demonstration by the veterinary faculty. A 250-kg local yellow cow was shaved and scrubbed for insertion of needles into the epidural space at the lumbosacral junction, between L1 and L2, and under a transverse process near L1 and L2 (a deep horizontal insertion). When the needles were attached to the current, the cow became immobilized,

and she was lowered to the mats by attendants. In about 10 minutes, the right paralumbar area was under complete analgesia; other parts of the body were sensitive, however, even to the touch of a fly. Surgical approaches were standard. Closures were all made with silk sutures. After skin closure with interrupted sutures, some large pressure sutures were placed across the entire incision. A bandage was incorporated into the pressure sutures.

Throughout the 40-minute operation, the cow looked alert and comfortable. She accepted and ate some green fodder. There was no salivation. The interpreter explained that acupuncture produces very little parasympathetic response. Upon completion of the surgery and removal of the needles, the cow immediately stood and walked away.

APPENDIX 1

# Equine Infectious Anemia Research at Harbin

David T. Shen

Equine infectious anemia (EIA) presents a serious problem to the 12 million horses in the People's Republic of Chine, 2 million of which are in the Heilongjiang Province. In some regions of the People's Republic of China, the rate of the EIA infection has been as high as 30 percent.

The EIA research laboratory at Harbin has 23 employees -- 12 scientists, 6 technicians, and 5 animal caretakers. Currently, they are studying both the humoral and cell-mediated immune responses to EIA in an effort to develop an effective EIA vaccine. They are also working on new diagnostic assays for detecting EIA in horses. Laboratory tests routinely used for EIA studies include complement fixation, cytopathic effect (CPE) in donkey leukocyte culture (DLC), horse (or donkey) inoculation, agar-gel immunodiffusion (ID), and the enzyme-linked immunosorbent assay (ELISA). Electron microscopy is also available for morphological studies. The fluorescent antibody technique is not routinely used for EIA viral detection. The ID test used at Harbin was designed after the Coggins method. In the United States, the Coggins test is the only assay currently available for detecting EIA in horses. The tissue culture-grown antigen used in China's ID test has not been compared with the EIA antigen used in the United States and Japan.

The scientists at Harbin followed the Kobayashi method of propagating EIA virus in a horse leukocyte culture (HLC) system. Because of the difficulty in propagating EIA virus in HLC, alternative methods were sought. The scientists found that the DLC was an easier system to cultivate, maintain, and use for propagation of EIA virus. After 10 years of hard work, they attenuated EIA virus through a series of passages in DLC, yielding an effective modified live EIA vaccine.

The basic scheme of EIA attenuation was as follows:

1. The virus was isolated from a horse with EIA.

2. The isolate was passaged 5 to 10 times in horses to yield a titer of $10^6$ tissue culture 50 percent infected doses ($TCID_{50}$) per ml.

3. The EIA isolate was subsequently passed 45 times in donkeys. At this time the isolate was highly virulent to both horses and donkeys. This virulent strain of EIA is a stock virus used to challenge the immunized animals in subsequent studies.

4. The virulent strain of virus was then passed 120 time in DLC, yielding an attenuated strain of EIA virus which remained antigenic but not pathogenic to the animals. Three isolates have been obtained in the blood of horses with EIA. These have been designated the L, H, and Y strains of virus. These three isolates show no differences in antigenicity or pathogenicity. The Chinese isolates have not been compared with the isolates from other countries.

Susceptible horses used for this study were obtained from EIA-free areas, isolated for 3 months before use, and shown to be EIA negative by ID. The EIA virus was initially isolated by inoculating infective serum onto DLC. Once CPE appeared, subsequent passages were made by freeze-thawing the infected cells twice to release the cell-associated virus and inoculating the infected supernatant medium onto uninfected DLC. Parallel negative controls were run with normal donkey serum.

The following observations were made during passages of EIA virus on DLC:

1. The CPE was seen in 5 to 6 days after inoculation in lower passages and in 3 to 4 days in higher passages.

2. The CF titers were consistently high from the 70th passage on.

3. Titration at various numbers of passages in DLC revealed that the virus titer of the culture was $10^6$ $TCID_{50}$ per ml before the 100th passage, and $10^7$ $TCID_{50}$ per ml at the 170th passage.

4. The virulence for horses and donkeys decreased as the number of passages increased. No clinical signs were observed in animals inoculated with cultures at the 120th to 150th passage. Modes of inoculation included intravenous, intradermal, and subcutanous.

The cultured virus was back-passed in horses and donkeys:

1. Fourteen horses were inoculated with virus from the 95th to 105th passage. The horses were bled at days 30, 48, 97, and 175 after inoculation. Blood (200 ml) from each bleeding was inoculated into susceptible donkeys (one donkey per horse). All donkeys remained clinically normal after inoculation. Donkeys were then challenged with a virulent strain of EIA virus, and all became sick or died after challenge, demonstrating the lack of protection.

2. Eight donkeys were inoculated with 10 ml of stock virus at the 125th-passage level. At the days 45, 60, 80, and 90 after inoculation, two donkeys were killed, and their blood and internal organis (spleen lymph nodes, liver, and bone marrow) were collected, pooled, and inoculated into susceptible donkeys. All donkeys remained normal after inoculation. All became infected or died after challenge with virulent virus.

3. Attenuated virus was back-passed in horses and donkeys. Results in several trials indicated that the attenuated virus could not be propagated for more than three passages. Whole blood (5 to 15 ml) and internal organs were used as passage materials. Passage intervals ranged from 2 to 4 months. The criteria for the presence of the attenuated virus were performance in complement-fixation tests and virulent virus challenge.

4. Attenuated virus from various DLC passages (90, 95, 96, 100, 105, 115, 118, 119, 122, 124, 125, 129, 131, and 135) was inoculated into a total of 62 horses by various routes and in various dilutions. After 2 to 4 months, the vaccinated horses were challenged with virulent virus. After challenge, 42 horses remained normal, 4 showed moderate signs, 3 were "suspicious," and 13 showed clinical signs of EIA. Five of the 13 horses with clinical signs died. The total protection rate was 79 percent. In the non-vaccinated control group, 100 percent showed clinical signs and 70 percent died after challenge. Vaccinated horses that showed signs after challenge had significantly longer incubation periods and lower death rates than horses of the non-vaccinated control group. Intravaneous inoculation of virulent virus should be avoided because the Chinese strain of EIA virus will be pathogenic regardless of the effectiveness of the vaccine. The highest dilution of attenuated virus from cell culture which produced immunity in horses or donkeys was $10^{-5}$. Similar results were obtained from the vaccine trials on donkeys, except that the protection rate reached 100 percent.

5. Immunity begins about 2 months after vaccination. Subcutaneous inoculation of the vaccine seems to be more effective than any other route. For up to 3

months after vaccination, the animal will have a positive antibody titer by the ID test. Thereafter, the EIA antibody is undetectable by this method.

6. Stability of the attenuated virus at various temperatures has been studied. The virus is stable at 15 to 20° C for 7 days, at 0° C for at least 60 days, and at -50° C for at least 400 days.

7. Two million doses of vaccine have been tried in various parts of the People's Republic of China. The EIA infection rate has dropped to 1 to 2 percent in Heilongjiang Province. The duration of immunity is currrently under study.

The pathology laboratory has begun the study of the immunologic mechanisms involved in effectively vaccinating horses against EIA. Preliminary data indicate that cellular immunity is important in controlling replication of EIA virus. The total number of lymphocytes decreases greatly immediately after vaccination but returns to normal 3 to 5 months after vaccination. The vaccinated horses exhibit a marked leukocyte migration inhibition (LMI) 10 days after inoculation. The LMI persists for an indeterminate amount of time; one horse has exhibited LMI for 4 years. In 1980, the laboratory was conducting leukocyte cytotoxicity tests.

For 75 years, EIA has been recognized as an animal virus disease. As with several other slow virus diseases, the

mechanisms that cause the persistent virus infection is a fundamental biological phenomenon that remains to be explained. Not long ago, scientists in Japan obtained some evidence suggesting that antigenic drift may occur in an EIA-infected horse, but no one has confirmed their observations. The vaccine data do not necessarily disagree with the Japanese observations. After 120 passages in DLC, the Japanese may have indeed selected out a strain that is perfect for a vaccine. Other scientists may be skeptical about the EIA vaccine at this time. Even some of the Chinese scientists in the universities and the Chinese Academy of Agricultural Sciences in Beijing are skeptical. The vaccine's effectiveness must be further evaluated before a conclusion can be made.

If the vaccine data are accurate and the EIA vaccine can protect the animal, then studies on other slow virus vaccines should begin. Perhaps EIA can serve as a model in the basic understanding of the immunological processes involved in slow virus infection.

The Chinese scientists as well as the government officials fully realize the need of basic research to substantiate their observations. They are eager and willing to cooperate with U.S. scientists in equine research. The US-PRC cooperative research on EIA will be mutually beneficial.

The Animal Disease Research Unit (Agricultural Research Service, USDA) at Pullman, Washington, in cooperation with the Washington State University Veterinary Pathology and Microbiology Department, is studying the mechanisms of virus persistence in EIA and the role of viral and immunological characteristics in

the control of disease expression. The ability of EIA virus to escape elimination by the host immune response and thus to persist for the life of the host is thought to be the consequence of two phenomena: the existence of a population of latently infected cells, in which the retrovirus persists in the form of integrated provirus; and the antigenic variation of the surface of virions or virus-infected cells. Thus, disease expression is the result of derepression of provirus function, which leads to the production of antigenically unique virus, which is not immediately controlled by the host immune system. Therefore, the following Chinese contributions will be immediately beneficial to U.S. equine research.

1. We would like to use DLC in agricultural research. At present, the HCL is the only cell-culture system available for EIA virus assay. For unknown reasons, the system requires specific horses as cell donors and specific cattle as serum donors for the culture medium. We have had to screen hundreds of horses and cattle to obtain such donors. This inconvenient system has hampered our EIA research a great deal. The DLC system is said to be much easier to maintain. The Chinese scientists are not yet willing to disclose their techniques in detail.

2. The Chinese EIA isolates are undoubtedly more virulent than the Wyoming strain used in the United States. Currently, we are experiencing difficulties in inducing

chronic EIA in horses with our EIA strains for study of the EIA provirus. The Chinese isolates should be incorportated into our studies because their enhanced virulence would make our experiments easier to interpret.

3. The effectiveness and safety of the Chinese attenuated virus used as a vaccine is unknown, even though the vaccine has been used in millions of horses in the People's Republic of China. This vaccine should be evaluated by a thorough investigation with a proper experimental design. If the results of the vaccine studies are positive, the value is obvious. If the results are negative, the general knowledge gained from such (cooperative) research, particularly in determining the virulent characteristics of various virus strains, would be valuable in the basic understanding of EIA.

APPENDIX 2

# Animal Diseases

John K. Atwell

Disease control programs in the People's Republic of China are basically prevention programs. There is, for all practical purposes, a program of vaccination for every disease for which there is a vaccine. Keeping out diseases not believed to be in the People's Republic of Chine is a major effort; for several diseases, there are vaccination programs along exposed borders to prevent the disease from gaining a foothold in the country.

This "prevention by vaccination" is apparently successful in many respects. The list of serious animal diseases that are "under control" or "no longer a problem" is impressive and includes foot-and-mouth disease (FMD), contagious bovine pleuro-pneumonia (CBPP), brucellosis, swine fever (hog cholera), equine infectious anemia (EIA), rinderpest, and swine erysipelas.

The laboratory diagnostic capabilities, in general, are meager; it is difficult to grasp the extent of a disease in the country. Although we saw the diagnostic facilities at the commune level and at the state farm level, these facilities were capable of few laboratory examinations beyond bacterial cultures and slide examinations. There is more capability at the county and provincial level, but we were unable to see any of these facilities. The research institute in Xinjiang-Uygur Autonomous Region, the municipal research institute in Shanghai, and the National Research Institute in Harbin had more sophisticated

diagnostic capability; but they apparently handle only difficult problems that are not solved by the lower-level diagnostic facilities. Obviously, the major function of these facilities is research; there is little routine diagnostic effort for diseases in the People's Republic of China. The team was unable to visit slaughtering establishments during the trip and thus cannot evaluate the surveillance of disease carried out by inspection at these facilities. The fact that slaughter establishments are inspected by the Ministry of Trade, not the Ministry of Agriculture, may have accounted for our inability to visit one.

Diseases of Swine

The Chinese report that they do not have FMD or swine vesicular disease.

There is a strict ban on importation of swine or pork products from any country with African swine fever (ASF) or where there is suspicion of the disease. ASF is a real concern to the People's Republic of China because porart of its animal protein production.

The major swine diseases that are of concern are swine fever, erysipelas, and Salmonella infections. Swine farms that we visited reported that they routinely vaccinated against these diseases two times per year.

The vaccine against swine fever is an attenuated lapinized vaccine developed by the Chinese and currently used in many parts of the world. The vaccine is produced in "factories" in the provinces; in some situations, it is produced locally by

injecting rabbits and using their spleens as vaccine material. There is a move to shift completely to factory-produced vaccines.

Other diseases mentioned as problems were Mycoplasma infection, Japanese B encephalomyelitis, pseudorabies (a sporadic problem), leptospirosis, and Escherichi coli infections (neonatal pig problems).

Transmissible gastroenteritis (TGE) is a problem, and in Shanghai, we were informed that virus of the TGE in the People's Republic of China seems to be serologically different from that in the United States or Japan.

Brucellosis in swine was not a problem, but on one state farm in Xinjiang-Uygur Autonomous Region, the swine herd is vaccinated for brucellosis as a preventive measure. The workers use the M5 (melitensis) if the swine are kept near cattle, but the S2 (suis) if they are not. The M5 is given once each year by injection, but the S2 vaccine is given twice a year by aerosol, in the water or on the feed.

The Chinese claim not to have a problem with atropic rhinitis, and we did not see evidence of it on the farms we visited.

The Chinese have tested for atrophic rhinitis in imported swine and have destroyed the last two shipments of swine from the United States because of atrophic rhinitis and blood diarrhea. Domestic swine are apparently not tested for the condition. Atrophic rhinitis is diagnosed by a tube agglutination test for Bordetella bronchiseptica.

Diseases of Cattle

Several diseases of cattle, such as FMD, CBPP, and rinderpest, that were a serious problem before Liberation have now been controlled.

Rinderpest was a serious problem, but by organizing in every county, exposing the masses to education, and conducting a massive vaccine campaign (a lapinized vaccine was used), the disease was eradicated in 1955. A caprinized vaccine had to be used to solve the problems in yak and Korean cattle. The Chinese continue to vaccinate cattle along the India, Nepal, and Tibet borders every 3 or 4 years as a preventive measure.

The introduction of FMD from Russia in 1958 led to a control program consisting of an isolation and slaughter policy. The control was not successful, and as an emergency measure, saliva was used as a vaccine. When Russia had a major FMD outbreak in 1962, the Chinese removed the cattle from the border and developed a plan to vaccinate annually for types A and O along the Russian border. The Chinese are currently using a mouse-attenuated FMD vaccine in cattle and sheep. The vaccine is produced at two factories.

Brucellosis is a problem in some Chinese cattle herds, especially in pasture areas. The Chinese have developed two "naturally" attenuated brucellosis vaccines that they believe are better for their use than strain 19. One is a strain of Brucella suis (S2) and the other is a strain of a Brucella melitensis (M5). These can be given by injection, aerosol, in the water, or on the feed. In one autonmous region, the vaccine is mixed with talc and dusted over the animals.

The level of brucellosis in dairy herds varies. One large dairy herd in Shanghai is considered free of the disease, and calves were vaccinated with strain 19. In other herds visited, the animals are vaccinated annually with one of the other types of vaccine. This vaccine program may be continued for as many as 5 years or until the herd is negative for brucellosis. Negative brucellosis status is defined as the absence of evidence of brucellosis in aborted fetuses, and new animals born in the herd are negative to the tube and plate tests. The Chinese feel that their dairy herds are "basically free" of brucellosis. There have been human cases of brucellosis in vaccinators.

Tuberculosis is a problem in some herds. Dairy herd managers test two times per year with the cervical and ocular tests. The procedure followed is to destroy clinical cases of tuberculosis, isolate reactors, save the calves, and develop clean herds in 10 years. There are apparently some tuberculosis-free herds and others that contain reactors. Beef herds are not routinely tested.

The CBPP vaccine is produced from a microorganism attenuated in rabbits. Th vaccine is administered in the tail annually in some border areas.

Anthrax is a minor problem in some areas, but vaccination is widespread, and clinical cases are destroyed.

Ephemeral fever was believed to have been introduced from Japan. Research on this disease is being done at the Research Institute in Harbin. Very little information about incidence was available.

## Diseases of Horses

Glanders is not the serious disease it was a few years ago. Human cases of glanders are found, mostly in hide handlers, and less often than in former years. The diagnosis is conducted with the mallein test on horses suspected of having glanders; no routine testing is carried out. If clinical cases are found, the animals are destroyed. Reactors to the mallein test are isolated for the rest of their lives. Oxytetracycline has been used, but with mixed results.

Equine infectious anemia (EIA) has been a serious problem in the People's Republic of China and the Chinese believe the major outbreak in 1959 came from Russia. At the Harbin Research Institute, it was obvious that much effort had gone into research for a vaccine for EIA. The Chinese have developed a vaccine and have used it in 3 to 4 million horses. The vaccine was developed in donkey leukocytes and passed many times, until it lost its virulence but did produce immunity. The Chinese have back-passed this vaccine virus; and, after three back-passages, they lose the virus. This has been repeated nine times. They claim to get 75 percent protection in horses and nearly 100 percent in donkeys.

## Diseases of Sheep

Sheep pox vaccine is used annually in infected areas. It is produced in chick embryos. No information was obtained about the incidence of the disease.

Rabies has been a problem in dogs and sheep in the northwestern part of the country.

Brucellosis, mainly melitensis, is a serious problem. The Chinese combat it by use of vaccines, either injected or given by aerosol, in water, or in dust form.

Sheep in the areas near the Russian border are vaccinated annually with A and O types of FMD.

Scabies is a problem in the Xinjiang-Uygur Autonomous Region. The problem was under control for many years but has recurred in recent years. The major problem is in the "private sheep flocks." Spraying of the flocks appears to be the method of treatment.

Parasites are a major problem.

Diseases of Poultry

The major poultry problems mentioned were Newcastle disease, fowl cholera, leukosis, Marek's disease, infectious bronchitis, fowl pox, laryngotracheitis, and Gumboro disease.

The poultry diseases are controlled by vaccination programs. Newcastle disease vaccinations have had some failures. There are many private poultry farms and these birds are not regularly vaccinated.

APPENDIX 3

# Nutrition and Management of Swine

T. D. Tanksley, Jr.

This appendix includes an overview of the basic structure of the Chinese swine industry, a few characteristics of the production systems, the nutrition and feeding programs, a list of the most critical needs in nutrition research, nutrition research being conducted at several universities, and opportunities for scientific exchange in swine nutrition and management between the People's Republic of Chine and the United States.

## Structure of the Chinese Swine Industry

Although an attempt to generalize about any agricultural endeavor in the People's Republic of China is extremely hazardous because of the tremendous diversity in various sections of the country, the following basic structure was observed:

1. State farms - primary function is to raise the purebreds and breeding animals for the province, but they were also involved in some production (large-scale finishing).

2. Communes - primarily serve as crossing farms that raise the pigs to be finished by either individual commune members or by state farms or the commune itself; however, in some areas communes were also involved in breed improvement or expansion work.

3. Individuals - do most of the finishing (one to three pigs per household), although the economics and practicality of large-scale finishing is currently being evaluated.

Characteristics of Swine Production Systems

On both the state farms and the communes visited, females were farrowed twice per year (spring and fall). They were farrowed in concrete-floor, open-front buildings with an alley on the north side or in enclosed buildings wieh a center aisle. Pens were usually about 2.4 m x 2.4 m with no guard rails but with a protected creep feeding area (no farrowing stalls or slatted floors were seen). The workers try to farrow only one sow per pen, but often move two sows and their pigs together when the pigs are 3 to 7 days old. The farrowing pen serves for the sow(s) and litter(s) until the pigs are weaned, at about 60 days.

Sows (during parturition) and pigs generally receive round-the-clock attention. Many of the farrowing-house workers were women, who were doing an excellent job. Pigs were often hand-watered in a small pan every 2 to 3 hours throughout the day and night. On one farm, workers marked each pig according to birth weight and attempted to place the smaller pigs on the second, third, and fourth nipples from the front so that they might get more milk, and the litter would be more uniform at weaning. Iron (and sometimes copper) was usually applied in liquid form to the nipple for the baby pig. At one state farm near Harbin, a precise management scheme was followed at weaning to reduce

weaning stress on both the sow and the pigs. Pigs were allowed to nurse only twice during the day on days 56 and 57, once on day 58, and not at all on day 59, before weaning on day 60; but pigs were allowed to be with the sow at night. When the restricted nursing program was begun, the amount of concentrate fed to the sow was reduced by one-half, and the weaning-to-estrus interval was shortened by withholding feed on the day of weaning (day 60). The program appeared to be working well: average time for return to estrus was 4 to 6 days.

On two farms, each worker was responsible for the entire management of 15 to 20 sows, except for breeding. Incentive programs were in operation on several farms in an effort to get a higher percentage of pigs weaned. On farms with 24-hour attention, weaning averages were usually 90 percent or higher of live pigs farrowed.

Apparently, the number of pigs farrowed, vigor at birth, and growth rate could be improved by following well-planned crossbreeding programs. Although workers at some farms were evaluating various crossbreeding programs, the best breeds fo maximum breed effects and complementarity have not been identified. Some of the most progressive crossbreeding systems were being evaluated at the Yanjiagang State Farm near Harbin. The breeders' expressed ambition was to use the native breeds for high litter size and roughage tolerance, and to cross them to other breeds to obtain higher gain and improved carcass merit.

Nutrition Program

Diets provided to the various classes of pigs varied widely in different areas of the People's Republic of China because they literally feed what they have available. Grain and high protein feedstuffs are severely limited. In addition to grain (corn, sorghum, barley) and high protein feedstuffs, the Chinese use all available grain byproducts (wheat, corn, and rice brans), excess vegetables (cabbage, sweet potato, pumpkin) in some areas, green fodder crops (comfrey, corn silage, millet), roughages (brewers' grain, sugarbeet pulp, bean curd, alfalfa hay, sweet potato vines) and water plants in the Shanghai area. One university scientist said, "We know about your NRC Nutrient Requirements of Swine publication, but we can't use it because we have to feed the pigs with what is availble." Both the feedstuffs and the amount available for swine feeding vary widely from area to area, from season to season, and from year to year.

An effort was made during each farm visit and in discussion with provincial leaders to find out how much grain and concentrate an individual had for feeding the pigs from weaning to market. The fact that several answers were obtained indicates that provinces, prefectures, counties, and communes differ in the kind and amount of concentrates available for livestock feeding. Adding to the complex situation is the fact that control of grain utilization (including soybean meal) is under the Ministry of Cereals. The Ministry of Agriculture is involved only with production. In each county the Grain Bureau of the Ministry of Cereals has a local office that buys the

grain for the Central Government and establishes guidelines on how the grain is to be used. Each production unit (state farm or commune) is allowed to keep a certain percentage of its grain production for human and animal food, but must sell a quota above these needs to the Central Government. "Feed companies" are under the Grain Bureau in some provinces, whereas others are attached to the Bureau of Animal Husbandry (under the Ministry of Agriculture). Certainly the amount of grain produced will greatly affect what is available for allocation to livestock feeding.

A general rule is that when a commune member, state farm worker, or anyone sells a finished pig to the Central Government, the seller is given market price for the pig plus the privilege of purchasing an amount of concentrate for each kilogram of hog sold. The amount varies (generally, 1 to 2 kg of grain for each kg of pig live weight) and the concentrate may be one or more of several feedstuffs. The concentrate may be formulated by the feed company according to the feeds available, or an individual may often be given the opportunity to choose from two or more concentrates. For example, he can choose 1 kg of corn or sorghum or 2 kg of wheat bran or other grain byproduct per kg of live hog sold. Some communes often allow the hog finisher to purchase additional concentrate from the commune if it is available. When acreage is available, the commune may allot 0.03 to 0.06 ha per hog finished to the commune member for growing feed for his pigs. This varies widely in different areas of the People's Republic of China because of the limited amount of land available and the need to grow food for humans.

Although most of the pigs are finished by individual commune members, the overall economics and desirability of the system appears to be under question. The large-scale confinement finishing units seen on two state farms and one commune have been constructed recently to evaluate this method of finishing. A front-page article in the Harbin daily paper while we were there questioned the efficiency of finishing in households compared with that in large-scale confinement. Two factors appear to favor the large-scale finishing units. First, the family unit can be more efficient only insofar as it uses table scraps (from the generally poor condition of pigs observed near the households and along the roadside, it appeared that only a few scraps were available). Second, because of the control exerted by the Central Government over production goals and the amount of concentrates available for swine feeding, the nutritional needs for finishing a specified number of pigs apparently could be more adequately provided on the state farms or communes.

## Feeding Programs

Gestation-Lactation. Several specific feeding programs are outlined in the individual trip reports. All programs involved use of a limited amount of concentrate (grain, grain byproducts, soybean meal) plus green fodder crops, silage, brewers' grain, alfalfa hay, or other available feedstuffs. Virtually the same feedstuffs were being fed during both gestation and lactation, but more concentrate was fed during lactation. The green fodder or roughage feeds were often fed ad libitum during both gestation

and lactation. Comparison of U.S. and Chinese feeding programs indicated that the Chinese tended to overfeed (both energy and protein) their pigs during gestation and underfeed during lactation, but this system may be efficient. Chinese sows need to gain more body weight during gestation than U.S. sows to milk well over a long lactation period (60 days). One research scientist indicated the need to feed silage or green feed to provide vitamin A, because of the high cost of vitamin supplements. Such supplements appears to be an area in which the United States could provide some expertise or supply the vitamin and trace mineral premixes at an economical price.

Creep Feeds. Workers at most farms offered pigs a concentrate mixture (finely ground) at about 10 days of age. A typical concentrate mixture contained 60 percent corn flour, 10 percent sorghum flour, 10 percent hay flour or bran, and 15 to 20 percent soybean meal (pressed cake). Several workers indicated that they included a small amount of fish meal (less than 3 percent) when it was available. They provided the creep several times per day, and pigs consumed it rapidly.

In one of the scholarly discussion groups, a research scientist asked why Chinese pigs usually weighed 15 to 16 kg at 60 days, whereas American pigs usually weighed 20 to 22 kg. Although this difference may not always hold true, two explanations for the smaller size of Chinese pigs at weaning were suggested: (1) lower milk production because of the lower energy and protein content of the lactation diet, and (2) inadequate quality or amount of creep feed. Many sows in late gestation with large litters were extremely thin.

Finishing. Workers at several farms used the same feeding program from the time the pigs were weaned at 60 days until they were marketed at 90 to 100 kg. Generally, weaning diets were low in both quality and quantity of protein as well as energy. Workers at some of the large-scale finishing units on the state farms and communes attempted to accustom the pigs to eating roughage feeds (silage and green fodder crops) immediately after weaning. This practice resulted in about a 2-month "post weaning lag," as one researchers expressed it. The delegation did not have the opportunity to observe the feeding programs carried out by individual commune members, but many of the pigs observed appeared to be deprived of protein and energy.

## Most Critical Needs in Swine Nutrition Research

1. Characterize feedstuffs available for swine feeding. Characterization should be done on a provincial basis because of the wide difference in feedstuffs available among provinces. Capability for performing amino acid analyses was observed only at the Research Institute of Animal Science and Veterinary Medicine, Shanghai Academy of Agricultural Sciences. Characterization of feedstuffs is critically needed for development of feeding standards and their implementation.

2. Establish feeding standards for the various classes of swine (gestating sows, lactating sows, weaned pigs, and growing-finishing pigs should have high priority).

These standards should be developed with the assumption that vitamin and trace-mineral premixes will be available at economical prices.

3. Until feeding standards are available, give more attention to both quality and quantity of protein, especially for weaned pigs, growing pigs (15 to 55 kg), and lactating sows.

4. Compare the anatomy of the native Ming and other breeds with respect to digestion of crude fiber. A 105-kg one-half Ming/one-half Harbin White (8 to 9 months old) was slaughtered at the Harbin Research Institute to determine whether any gross differences in the size of the digestive system could be observed. The results were:

| Character measured | Ming-Harbin White | Literature values[a] |
|---|---|---|
| Stomach volume, ml | 5575 | 5200 |
| Small intestine length, m | 19.7 | 18.8 |
| Cereal volume, ml | 3000 | NA |
| Colon length, m | 5.0 | 5.0 |

[a]Digestion in the Pig, Kidder and Manners, 1978.

5. Determine whether more energy and protein for feeding hogs can be produced from a hectare of grain, green fodder crops, silage, or other feedstuffs that are commonly grown for swine feeding.

6. Evaluate finishing hogs in large-scale confinement programs and those raised by the present method of finishing one to three pigs per household. Carcass merit (lean-to-fat ratio) should be included in the evaluation.

7. Develop vitamin and trace-mineral premixes that can be used throughout the People's Republic of China.

8. Improve feed-mixing techniques. All the mixing that we observed was being done on the floor with a scoop--feed mixers were present at two locations but were not being used.

9. Develop better quality control of ingredients insofar as possible. For example, all the salt being mixed into diets was very coarse grained (similar to U.S. ice cream salt). For even distribution throughout the diet, the salt should be finely ground.

Nutrition Research Programs at the Universities and Research Institutes

Seven agricultural colleges in the People's Republic of China are under the Ministry of Agriculture. These include:

1. Beijing Agricultural University
   (Beijing, Beijing Municipality)

2. Northwest Agricultural College
(Wugong, Shanxi Province)

3. Northeast Agricultural College
(Harbin, Heilongjiang Province)

4. South China Agricultural College
(Guangzhou, Guangdong Province)

5. Nanjing Agricultural College
(Nanjing, Jiangsu Province)

6. Gansu Agricultural College
(Huangyangzhen, Gangsu Province)

7. Shenyang Agricultural College
(Shenyang, Liaoning Province)

Our group participated in seminars and discussions with scientists from three of these agricultural colleges (Beijing, Northeast, and South China) but had the privilege of visiting only the South China campus to see their facilities. Without exception, research scientists from these universities were involved in several practical and sound research projects (they were only getting started in some areas). We were particularly impressed with projects at Northeast and South China that included characterization of feedstuffs available for feeding, establishment of feeding standards for the various classes of swine, and study of anatomical systems (from both morphological and histological standpoints) between the native Ming and other breeds in an effort to determine whether, and if positive, why the Ming can digest crude fiber more efficiently. These are

excellent projects. Apparently, research is well planned and progresses well when direction and financial support are provided by the Central Government.

Opportunity for Scientific Exchange in Swine Nutrition and Management

This visit provided reliable information about the present status of the swine industry in the People's Republic of China and can be used as a base for scientific exchange between the two countries in the future. I feel strongly that the greatest return for the money invested and greatest improvement in programs will result from:

1. Exchange of scientists for short periods of time to specific universities to help in specific program areas or with specific problems.

2. Training of Chinese graduate students in the United States. Perhaps this would yield the greatest return on investment during the next 50 to 100 years.

APPENDIX 4

# Breeding and Genetics

Lawrence D. Young

The application of genetic principles to dairy cattle improvement in the People's Republic of China is very similar to that in the United States and other countries. It relies heavily on the development of an artificial insemination (AI) program. The AI program in the People's Republic of China seems to be well developed and quite successful. However, testing programs need to be well developed so that only truly genetically superior bulls are used for AI. If the testing program is not carefully conducted, semen from inferior animals can be spread as quickly as semen from superior animals. In other words, an AI program is only as good as the testing program in aiding genetic improvement.

Several beef-type and dual purpose-type bulls were present at each station we visited. The intent is to upgrade the native cattle to the dual-purpose type, such as Simmental and Brown Swiss. The cow herd would be the dual-purpose type, and the true beef-type bulls could be used to produce market progeny. Given the resources available for feeding cattle in the People's Republic of China, this is a very good approach. A moderate level of milk production can be maintained under average conditions for immediate local consumption and a good calf can be produced for meat. If one concentrated only on beef production, one would lose the bonus of milk production. A high-

producing dairy cow could hardly exist under average conditions in the People's Republic of China and still produce a calf each year. Additional work is needed in establishing selection goals and procedures for dual-purpose cattle.

The only information we received on sheep was at the Urumqi Breeding Farm. This farm maintained about 2000 Fat-Tail (Kazak) and 6000 Fine-Wool (mainly Rambouillet) ewes under extensive range conditions. No specific genetic improvement programs were outlined. Some Australian Merino and Polowirth rams had been imported and bred to the Fine-Wool ewes to increase fiber and staple length in the flock. The use of superior breeds to upgrade existing populations is a valuable method for quickly improving performance. However, specific production goals and selection programs to reach those goals should be established to ensure further genetic improvement and improved production efficiency in the Fat-Tail and Fine-Wool flocks and in sheep throughout the People's Republic of China.

Although we visited many swine breeder farms, little specific information was available on genetic improvement programs. In general, the Chinese stated that they selected on performance of parents and progeny as well as that of the individual. In response to questions about specific traits used in selection, the traits most often mentioned were visual criteria related to the body type. As more traits are used in selection program, less progress is made in each trait. Less emphasis should be placed on visual appearance, and more emphasis should be placed on the production traits, such as reproduction, growth, and carcass quality, which affect the

efficiency of the production unit. Many of the elite herds in which selection is being practiced are small, and their breeding stock is too old. The small population size would lead to rapid inbreeding if generations were turned quickly. Generations should be turned quickly to make more selection progress.

Many sows were kept in the herds until they were 4 or 5 years old. This practice slows the rate of inbreeding per year but also slows the rate of selection progress per year. The large number of swine breeds available throughout the People's Republic of China offers researchers, state farms, and communes a unique opportunity to find or develop genetic stocks specifically adapted to their conditions. There is evidence that such stocks are being found and developed. Each province or municipality has a breed of pig with its name on it. However, most of these breeds appear very similar and were developed by grading-up the native pig to the Russian Yorkshire. For optimum use of the other genetic stock in the People's Republic of China, a large-scale germplasm evaluation program is needed. This program should be well designed and conducted at a single location or at several locations, with the use of reference breeds. With the changes that have taken place in the swine populations and in the needs of the people, a large-scale germplasm evaluation program would be very useful in constructing mating systems and choosing breeds to optimize commercial production.

Some of the researchers at Harbin were beginning experiments to evaluate the relative responses of various genotypes to various fiber levels in the diet and to conduct a

detailed comparison of reproduction in various breeds. We also visited two laboratories in which researchers were evaluating breeds for blood types and seroproteins and were mapping chromosomes. These types of data can add not only to Chinese knowledge, but also to worldwide knowledge of basic physiological differences among strains of swine, and many of the strains are found only in the People's Republic of China.

Breeds could be imported into the People's Republic of China to use in crossbreeding systems with indigenous breeds or to upgrade indigenous breeds. In either usage, the imported breeds should be adaptable to the conditions in the People's Republic of China if they are to perform up to their genetic ability. The feeding regime in the People's Republic of China is based more on roughages and less on concentrates than regimes used in other parts of the world. Many breeds developed under concentrate feeding programs may not do well or may not even survive under the typical feeding programs in the People's Republic of China.

We did not receive any information on genetic improvement of egg-laying chickens. Most of the stock were imported many years ago, and little genetic improvement has taken place since their importation. It seems that the People's Republic of China could quickly raise the level of egg production by importing some new improved strains.

APPENDIX 5

Organization of Agriculture

John K. Atwell

The Ministry of Agriculture is responsible at the national level for veterinary services and animal husbandry. The Ministry of Agriculture has responsibility in many other areas of agriculture, but our concern was the control and delivery of services associated with animal diseases and animal husbandry. The major divisions at the national level dealing with these two areas of responsibility are:

1. The Central Bureau of Animal Husbandry and Veterinary Science. This bureau is responsible for establishing the monitoring animal diseases and animal health programs of a regulatory nature. It is also responsible for developing animal husbandry programs.

2. The Control Institute of Veterinary biologics and Pharmaceutics. This institute is responsible for establishing protocols for the production of veterinary biologics, assuring that production of veterinary biologics conforms with established national procedures and standards, and for doing some research in veterinary biologics and in traditional medicines. The institute is the repository for bacterial and tissue cultures.

3. The Chinese Academy of Agricultural Sciences. The academy is responsible for the national efforts in research on animal diseases and animal husbandry.

The meat inspection programs in the People's Republic of China are not under the Ministry of Agriculture, but are handled by the Ministry of Commerce. Politically, the People's Republic of China is divided into provinces, municipalities, and autonomous regions. These political subdivisions correspond to states in the United States: respond to the National Government but have a great deal of autonomy. In animal health matters, officials present their plans to the Ministry of Agriculture in Beijing and receive approval of their overall plan. Obviously, there is considerable flexibility for local differences in the administration of animal disease programs.

The next lower level of organization is usually a regional bureau of agriculture or in some regions a regional bureau of veterinary science and a regional bureau of animal husbandry. At the county level of government, there is a bureau of agriculture or, in some counties, a bureau of animal husbandry and veterinary science. These county level organizations have responsibility for veterinary hospitals, disease prevention, diagnostic services, and breeder farms. Farm communes have animal husbandry and veterinary groups that are responsible for disease prevention, veterinary medicine, and diagnostic services within the commune. These communes answer to the county government.

The delivery of animal health services in the People's Republic of China is through the local and county governments, which answer to the provincial government, which, in turn, answers to the National Government. A few research establishments are responsible directly to the Ministry of Agriculture, and at least two veterinary biologics factories are responsible directly to the National Government. The veterinary service delivered at the commune and state farm level is often a combination of Western style medicine and Chinese traditional medicine, which includes herbal treatments and acupuncture.

Although there appears to be a great deal of autonomy for the provinces in animal health programs, the Chinese have mounted major campaigns to vaccinate against such diseases as contagious bovine pleuropneumonia, rinderpest, foot-and-mouth disease, and hog cholera. Some of these campaigns have been on a very large scale and some were nationwide. These campaigns have been successful in containing these diseases.

APPENDIX 6

# Animal Reproduction

George B. Rampacek

This summary will include some general comments on the state of animal reproduction in the People's Republic of China and the current research in reproduction, and some recommendations for future scientific exchange in the area of reproduction.

Because of the many changes in the People's Republic of China during the past 30 years, research progress in most scientific fields has been very slow or nonexistent. Many of the institutions had reassembled the scientists and faculty members in the past few years. In many institutions, little or no facilities were available for scientific research; therefore, the only research being done was that which could be done on state farms or in communes. The Chinese scientists whom we met appeared to be aware of the general areas of research being conducted around the world, although specific scientific knowledge seemed to be lacking because of their inability to obtain reference literature.

Most of the scientists were middle-aged or older, with an almost complete lack of scientists in the younger, 25- to 45-year-old group. The People's Republic of China has to make a concerted effort to rapidly train a large number of scientists so that there will not be a standstill in research when the older scientists retire in the near future. To this purpose,

the People's Republic of China should be encouraged to send qualified persons for postgraduate and postdoctoral training to the United States.

There appeared to be a lack of reproduction research in most areas of the People's Republic of China. With cattle, the use of frozen semen and artificial insemination (AI) was widespread. Although the techniques were not up to date, the Chinese indicated that more modern techniques were going to be incorporated. There were indications that embryo transfer in cattle was also being worked with, but the information to evaluate the state of the art was not available. Some research was being conducted with estrus synchronization in cattle, sheep, and pigs; but again, the methods were not modern, and there were numerous requests for information on the use of prostaglandins for estrus synchronization in cattle and the compounds used for estrus synchronization in pigs. The use of radioimmunoassays (RIA) for measuring blood concentration of progesterone, luteinizing hormona (LH), and estradiol in sheep was reported at the Xinjiang Research Institute of Animal Science. Our delegation was not able to visit the RIA laboratory or talk with any of the research leaders of the laboratory to assess their capabilities. They requested, at the end of our discussion, the National Institutes of Health (NIH) standards for follicle-stimulating hormone (FSH) and LH and for progesterone and estrogen standards.

Apparently, the major aim of current reproductive research with swine was to describe reproductive characteristics such as age at puberty, ovulation rate, time of ovulation, and embryo

survival in the various native breeds of swine within each region. In some regions, native breeds were being compared with native-import crosses and with imported breeds. This type of research is necessary and should be continued because of the large numbers of breeds and the present lack of scientific data on the reproductive characteristics of the various breeds.

Several breeds have large litter sizes and attain puberty at an early age. The Tai Lake breed was reported to attain puberty at 4-1/2 months of age and produce 15 pigs per litter. In a limited study in Harbin, the Ming breed was reported to have 19.3 ovulations and a litter size of 13 pigs. In Shanghai, at the Brick Bridge Commune breeding farm, the Funjing (a strain of Tai Lake) was reported to have a litter size of over 15 pigs, with 13.3 pigs born live and 12.4 pigs weaned. The Funjing was also reported to attain puberty at 3 to 4 months of age, although the gilts are not bred until 8 months of age. Note that the litter size of 15 pigs is an <u>average</u> litter size. At the Brick Bridge Commune farm records were available on all litters farrowed for each sow. Consistently, after the first or second litter, many sows were farrowing 22 to 25 pigs per litter, although the survival to weaning rate was still 12 to 13 pigs.

Most places visited had experimented with AI in swine, but conception rates were generally lower than should be expected with the breeders' admitted lack of knowledge and improper AI technique. If swine production in the People's Republic of China is to shift from the present labor-intense system to a more labor-efficient system, the Chinese must develop better knowledge in applied reproduction techniques.

## Recommendations for Future Scientific Exchange

1. The Tai Lake and Funjing breeds of swine should be used by both Chinese and U.S. animal scientists to study the physiological mechanisms controlling early puberty and large litter size. Because of importation restrictions, Chinese native breeds probably could not be imported to the United States. Therefore, the People's Republic of China should be encouraged to set up a research farm and laboratory, perhaps around Shanghai, where U.S. scientists could work cooperatively with Chinese scientists for 3- to 9-month periods.

2. The People's Republic of China should be encouraged to send highly qualified postgraduate and postdoctoral persons to the United States for further training in both basic and applied animal reproduction.

APPENDIX 7

# Animal Virus Research

David T. Shen

The People's Republic of China often is compared with the United States, for they are equal in area and occupy similar latitudes. However, there are many differences between the two countries, the most marked being that a large proportion of the land in the People's Republic of China is unsuitable for settlement in agriculture. Most of the People's Republic of China's 1 billion people are concentrated in the eastern part of the country, where most of the cultivated land is located.

Domestic animals in the People's Republic of China are similar to those in the United States; however, swine are the predominant meat animal in the People's Republic of China, as cattle are in the United States. The People's Republic of China has 350 million pigs, 70 million cattle (including buffalo), 70 million goats, 100 million sheep, and 12 million horses. Dogs are not allowed in the city, and cats are kept only for rodent control. Therefore, Chinese veterinarians deal primarily with food animal medicine.

Important virus dieases in the People's Republic of China are hog cholera (swine fever), transmissible gastroenteritis in pigs, Japanese B encephalitis in pigs and horses, pseudorabies, Newcastle disease, Marek's disease, avian leukosis, chicken pox, avian infectious bronchitis, bovine leukosis, bovine ephemeral fever, sheep pox, equine infectious anemia, and Aleutian disease

of mink. Rinderpest and foot-and-mouth disease have been eradicated. However, animals near the border are still vaccinated to ensure protection. The Chinese have never recognized swine vesicular diseases or bluetongue in cattle or sheep.

Vaccination, sanitation, and intensive individual care are the primary methods for disease control and prevention. The Chinese routinely vaccinate animals against many of the above-mentioned diseases. Because sufficient manpower is available, vaccination programs are not expensive. The People's Republic of China seems to be able to make its vaccination program efficient and economical. First, there is no extra labor cost, because everyone has regular jobs and no one gets extra pay for vaccinating animals. Second, the government makes vaccines at a very low cost. There are no commercial manufacturers. Third, the well-organized people's commune system and state farms make vaccination programs easier to conduct. Vaccination procedures are followed quickly and thoroughly.

The Chinese had an interesting experience using vaccination against rinderpest in the early 1950's. During those days, transportation was very poor in most areas. There was no lyophilized vaccine, and cold storage, which is imperative for the transportation of the vaccine, was not available. To overcome these problems, the Chinese inoculated a group of young cattle or sheep with the rabbit-attenuated rinderpest vaccine. These animals were then driven to various vaccination stations. By the time the animals reached their destination (usually 4 yo 6 days), they had started to respond to the vaccine. Blood and

spleen were collected, and the vaccine was prepared from these materials. This procedure could be repeated, and the stock vaccine virus would be carried to various vaccination stations by live animals. However, to prevent a reversion to virulence, the vaccine virus was never passaged in cattle or sheep more than 10 times.

The research facility standards varied greatly among laboratories we visited. The Harbin Veterinary Research Institute and the Shanghai Veterinary Research Institute were the best equipped laboratories we saw during the whole trip. There, the Chinese had instruments that were adequate for most of their research and diagnosis, including such instruments as an electron microscope and an amino acid analyzer. Much of the equipment was made in the People's Republic of China, including automatic temperature-controlled incubators, water baths, low- and middle-speed centrifuges, spectrophotometers, pH meters, and automatic cell counters. Facilities in other laboratories, especially in the universities, were poor. Diagnostic virology laboratories were virtually nonexistent.

The Harbin Veterinary Research Institute seems to be doing most of the virology research in the People's Republic of China. The Institute focuses its efforts on practical immunology and virology, such as vaccine development and new diagnostic assays. Many attenuated live virus vaccines were developed here. Recently, the Chinese announced that they had developed an equine infectious anemia (EIA) vaccine attenuated in donkey leukocyte culture. The Chinese are also beginning to study cell-mediated immunity and ultrastructure of the EIA

virus. Their biochemistry laboratory is using recombinant DNA techniques to develop vaccines. Virology research in other laboratories was generally poor. Basic diagnostic tools are inadequate. Tissue culture techniques are in general used in many laboratories.

There are 10,000 formally trained veterinarians in the People's Republic of China, and 1000 to 2000 are engaged in research. On the basis of training, scientists in veterinary research can be categorized into three groups: those who received college training or its equivalent under the Japanese system before World War II, those who received college degrees in animal husbandry and veterinary science before the Cultural Revolution in the People's Republic of China, and those who have had additional training abroad. Most scientists are at least 40 to 45 years old. They have a good background in classical bacteriology, pathology, and parasitology but a definite lack of knowledge in molecular biochemistry, virology, and immunology.

In the People's Republic of China, access to foreign periodicals is limited. Shortages of scientific textbooks and periodicals are common. Often a scientist has to travel a long distance to read an article. Indeed, many laboratories we saw had many empty bookshelves. The textbooks on scientists' desks, such as those on bacteriology, virology, and parasitology, were published in the 1950's.

The enzyme-linked immunosorbent assay (ELISA) is a newly developed technique for the detection of antibody or antigens at an extremely sensitive level. Its advantages are that it is economical, fast, and simple to perform, and it requires no

expensive equipment. In the United States, its popularity has just started in the past few years. In every Chinese laboratory we visited, there was always someone either doing the test or about to do it. The Harbin Veterinary Research Institute has adapted ELISA for EIA viral antigen detection. This illustrates the point that although China's technology is 15 to 20 years behind the current status of development, it certainly would not need a long time to catch up. The Chinese can immediately adapt the latest technology and save the many years of development time that we have had to spend.

Chinese veterinary scientists are very interested in slow virus diseases because of the People's Republic of China's two slow virus disease problems: EIA and Aleutian disease (AD) of mink. The EIA presents a serious problem to the 12 million horses in the People's Republic of China. As mentioned previously, the Harbin Veterinary Research Institute has developed a donkey leukocyte cutlure-attenuated vaccine against EIA.

The People's Republic of China is expanding its mink industry. The Chinese plan to produce 2 million pelts in 1981. The Harbin Veterinary Research Institute has been given funds to study mink diseases. Canine distemper and AD in mink are the two diseases currently under study. The Chinese are adapting the counterimmunoelectrophoresis for diagnosis of AD and are developing a chick embryo-attenuated distemper vaccine. Mink virus enteritis and hemorrhagic pneumonia (a bacterial disease) are not considered to be major problems. In Xinjiang, the small

experimental mink farm at the August 1st Agriculture College has all color phases known. The mink looked healthy and active, but small.

A third slow virus disease that may occur in the People's Republic of China besides EIA and AD is progressive pneumonia (PPV) of sheep. Xinjiang scientists have been unsuccessful in attempts to isolate the virus from sheep showing clinical signs of PPV. Scrapie and visna have not been recognized in the People's Republic of China.

Because of the lack of diagnostic technology and facilities, the lack of recognition of many animal diseases in the People's Republic of China does not necessarily indicate that they do not exist there. This fact is particularly true for virus diseases. The People's Republic of China immdiately emphasizes the adaptation of new diagnostic techniques to identify disease problems before any measures for control and prevention of importation can be initiated.

The progress in science and technology in the People's Republic of China came to a halt for almost 15 years. The highest priority in China's modernization should be full effort in training a new generation of scientists.

ANIMAL SCIENCE AND HEALTH DELEGATION

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|---|---|
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